January 1972
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73 magazine

for radio amateurs



✶73 Tests: Allied AX-190, Simpson Model A, IC-21, Regency Transcan, CT Power Amplifier

- 2M Antenna
- RTTY Art
- SSTV
- News
- IC Projects
- Perils of Skirting Ma Bell
- Novice
- Morse Code Controversy
- Only a bare hint of FM
- & More

73 magazine
for radio amateurs

#136 JANUARY 1972

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Amateur Radio

JANUARY MCMLXXII Monthly Ha

FAMILY HELPED BY AMATEURS

SON STRICKEN IN GERMANY

(Reprinted from the Williamsport Sun-Gazette) Mr. and Mrs. William J. Shannon recently learned that kindness can extend for thousands of miles.

On Sept. 1, the Shannons got a cable from their son, John, saying he was ill in Heidelberg Polyclinic Hospital, Heidelberg, Germany. He had been on vacation in Europe. He is head of the music dept. at Wyoming Seminary, near Wilkes-Barre.

Mrs. Shannon called the hospital, but was told that no John Shannon was listed.

"We were really worried," recalled Mrs. Shannon. "John wouldn't have cabled unless he was seriously ill."

The Shannons tried to contact their son by cablegram but with no success.

Finally they went to the Red Cross, but that attempt also failed. The Red Cross suggested however, that Mr. and Mrs. Shannon try to contact Germany by ham radio.

Mrs. Shannon's brother, Robert Stout W3NEN, put them in touch with Donell Godfrey K3QFW, the past president of the West Branch Amateur Radio Club.

"Mr. Godfrey is the hero of this story," said Mrs. Shannon." He's the one who helped us get into contact with someone who knew about our son."

On his radio, Don contacted Guenther Herzog in Hemer, Germany, about 250 miles from Heidelberg.

Fortunately, Herzog had a friend who was on the staff at the Heidelberg Hospital. Herzog learned that John Shannon was indeed in the hospital and seriously ill with a strange type of virus.

"They aren't sure what type of virus John has," his mother continued, "but one doctor in Austria said he could have gotten it from eating bad meat or ice cream."

Herzog offered his home to John when he leaves the hospital if he needs rest before returning home.

The Shannon's eldest daughter, Carol, an airline stewardess, flew to Germany to see her brother. "The doctors said that seeing her was the best medicine," the mother said.

Carol called her parents last night and told them John was much better. She plans to bring him home soon. It will probably be a while, however, until he returns to teaching.

Mrs. Shannon was much relieved today after the trying experience. "It seems like a small world," she said, "when people like Mr. Godfrey and Mr. Herzog will go out of their way to help you."

JOHN GORE SCHOLARSHIP AWARDED

Alan Scott WB2TCZ, of Paint Post, New York, was this year's recipient of the John Gore Memorial Scholarship. Judged to be the most scholarly and deserving of applicants nationwide, on September 23rd, Scott was awarded the $500 scholarship. John Gore was an outstanding past president of the Foundation for Amateur Radio, a group of twenty-seven radio clubs in the Washington, D.C. area.

Alan Scott is an electrical engineering student at the University of Cincinnati, has been on the Dean's list several times, and participates in a co-op program with the Naval Research and Development Center in Carderock, Md.

Information about this scholarship will be available in *73* in a few months.

Swiss Scouts In JAMBOREE



Recent participants in the Jamboree On The Air held in October.



Lele HB9AMY, in the San Gottardo, Lugano -TI- Scout Section, allows local scouts to talk with other scouts in other parts of the world.

Contest Announced

The Potomac Area VHF Society Challenge Competition consists of a contest with any club that dares to compete in the January VHF Sweepstakes. Take your club aggregate score, divide by number of members, multiply by percentage of members participating. Clubs must have six or more members and have been in existence since 1/1/71. At least fifty per cent of the members must have been in the club before 7/1/71. Honor system will be used in computing scores. Highest scoring club by this system, other than PAVHFS, will receive an engraved trophy. Any club scoring higher than contest sponsor will receive a handsome certificate. All mail handled by K3LNZ.

News Pages

IN WORCESTER, MASSACHUSETTS:

FM SYMPOSIUM FEB. 12th

A full-fledged hassle and exposition is in the works for mid-February in the Worcester (Mass.) area. If you have any interest in FM, two meters, ham fist-fights, looks at the newest developments in ham gear, and such, you might consider braving the wintry winds of central Massachusetts and heading for a full day of enervation at the First New England FM Symposium.

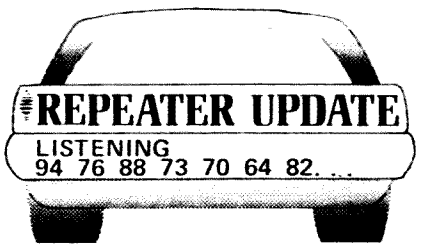
The need for some sort of general conflab of the 40-plus repeater groups in New England reached the level where even 73, which has taken little note of this new-fangled flash-in-the-pan FM fad, felt constrained to follow the lead of its publishing compatriots and make a fast buck while the pickin's are thick.

The Symposium will attempt to get the 40 groups face to face in the hope that a frequency coordinating board can be named to plot the progress of repeater allocations in New England. Arguments will be heard on closed vs open repeaters, television and RTTY repeaters, touchtone vs tone burst entry and control, big vs little repeaters, repeater tie-ins, and plans will be discussed for expanding repeater operations to other bands such as 75m, 40m, 20m, 10m, 6m, and even 220 and up!

Watch the February issue of 73 for final details on place and program. The program will start at 10 am and last through until late that night. Talk-in will be through any of the dozen or so nearby repeaters or on 94 direct. Listen 19-79 WA1KGO, 37-97 WA1KRJ, 25-76 K1MNS, 34-94 K1AIU, 34-94 WA1KGR, 25-79 WA1KGZ, 22-82 W1HWK, 28-88 K1AOI, 01-64 WA1KGS, 04-91 K1FFK, 10-70 WA1KFZ, etc.

NEW FREQUENCY SYNTHESIZER IN THE WORKS

Vanguard Labs is hard at work on their frequency synthesizer for FM and you should see announcements soon for a transmitter model with output on 6, 12 and 18 MHz for two meter transceivers and hitting every 10 kHz for around $100. This one will operate over a ±10° C temperature range. André will have one for −10 to +70° C for around $150.



AZ	K7ZMA ?	Hyden Peak, Hualpia Mtn. 8400', nr Kingman AZ	34	94
CA	WA6CHZ	Los Angeles	145.15	49
CO	WAØSNO	Pueblo	34	94
			28	88
CT	WA1KGB	Farmington	37	97
IL	WB9HWS	Change from 22 70 to 2000 Hz tone	04	64
		Change QTH to Western Springs		
IN	K9JSI	LaPorte	22	82
IN	W9CFJ	Michigan City	31	97
MA	K1AIU	Framingham	34	94
MA	WA1KEQ	Cape Cod	07	67
MA	WA1MHN	Somerville	34	94
ME	W1QXR	Bangor	34	94
MD	K3BEQ	Cheverly	01	61
MD	WA3PVP	Wheaton	07	67
			223.30	224.30
		Autopatch	448.3	449.3
MI	WB3CRK	Detroit	449.0	444.0
MI	W8MAI	Benton Harbor	22	82
MN		Duluth	34	94
NH	WA1KGO	Peterborough	19	79
NY	WB2BEQ	Yonkers 4 APL	31	91
NY	WA2PDJ	Change from 52 76 to 146.445 147.36		
NY	WA2UZE	Huntington	52	76
NY	W2WJS	Bayside	41	64
OH	WA8WMH	Butler Co	37	97
OK	WA5YUH	Durant	34	94
OR		King Mtn	34	94
OR		Mary's Peak	34	94
PA	W3BN	Change from 52.525 .640 to 52.575 .680		
PA	W3OI	Allentown	34	94
PA	WA3QCE	Pittsburg logging info first 15 sec 1st transmission	34	86
PA	K3UQD	Delete from list		
PA	WA3WJU"	Scranton	34	94
SC	WB4QGK	Charleston	34	94
WA	WA7KGV	Bawlaw 1.95 kHz tone burst	34	94
WI	W9AYR	Green Bay	28	88

Thanks to WA9SXN, WB9HWS, K9DZE, WA9AFM/Ø, K8ZOA, K7ZMA, K5BNK, W3WJC, K3BEQ, K2VWZ, W1KJL, W1GBO, W1BHD, W1AGJ.

Please, when reporting repeater activity, give call letters and location. Club bulletins often omit these items but we need it to adequately inform our readers.

Tone-burst Freq's - 1.5, 1.65, 1.8, 1.75, 2.1, 2.25, and 2.4 kHz.

MASSACHUSETTS HAM WINS COMMUNITY SERVICE AWARD

73 salutes W1NN of Reading, Mass., who, according to the *Reading Chronicle*, is the recipient of the radio station WEZE Community Service Award. Theodore Barron, an active phone-patcher, earned the award for helping people in need throughout the Western Hemisphere. In recognition of this feat, we congratulate you for typifying the ham radio operator as dedicated to public service.

HOT GEAR

House of K2AOQ, Melvin Stoller, 373 Park Ave., Rochester, N.Y. (716-244-2839) burglarized Sept. 26. New GE Personal Portable Master Radio, model PR-36-RFS-55, S/N 1041218. Set up for 28/88, 94/94, 34/94, 34/76. Reward for info leading to recovery. Contact Mel or Rochester Police, Detective Division.

S-Line stolen from Colorado State Univ. during summer. 75S3-B S/N 15640; 32S3 S/N 12000; 516F2 S/N 1649; all have distinguishing marks. Contact W. Solfermoser, 1905 W. Lake, Ft. Collins CO 80521 (482-9668) or Dave Balsick, 515 S. Meldrum, Ft. Collins CO 80521 (493-4774).

STOLEN: Simpson Electronics Model-A FM transceiver (serial number 35457) and a Hy-Gain Diplomat-2 5/8 wavelength mobile whip with magnetic base. de W2PWG. Robert F. Scott, 9 Jackson Avenue, Brentwood NY 11717.

HOT GEAR CUMULATIVE LISTING

Mfr., Model, Ser. No.	Owner	Issue
Halli., SR46A, #446100	WA1EMU	9/71
Reg., HR-2, #04-03505	WA5BNM	11/71
Sonar, FM3601, #1003	WB2ARM	11/71
Coll., 75A4, #804	WØMGI	12/71
GE, Portable, #1041218	K2AOQ	1/72
Coll., 75SE-B, #15640	Col.St.U.	1/72
Coll., 21S3, #12000	Col.St.U.	1/72
Coll., 516F2, #1649	Col.St.U.	1/72
Swan, 350, #C567347	WA8NIB	---
Hamm., HXL-1, #33841269	KZ5MM	---
Mos., TA-33,	KZ5MM	---
Telr., 2M-814	KZ5MM	---



EDITORIAL BY WAYNE GREEN

Ten Meter FM Link

A call from W7DXX got the juices boiling for a ten meter link channel between FM repeaters around the country, or even around the world. As a result I have ordered a little ten meter FM rig which we will be setting up in conjunction with WA1KGO to send and receive on 29.68 MHz with tone access from the 19–79 two meter service.

When six meters opens up I have a great time through W1ALE in Concord, N.H., which has a 52.525 MHz function connected to its 46–94 operation. Ten should be even more fun since it opens a lot more than six does.

Say, I'll bet all those swingers down on 3999 kHz would really dig a link to that channel through your repeater! How about it? It would wake 'em up for sure. When you do it please be sure to make careful notes of the ensuing bedlam and send them to *73* for the newspages.

In the meanwhile, how about getting set up on 10m so we can have some news of mobiles in Munich talking via 2m–10m repeater to Oregon?

Expanding the Tech Band

The FCC has been sitting on several proposals to expand the Tech frequency allocations on two meters. If, for some reason which is really not too apparent, the FCC is reluctant to let the Techs use all of 2m, perhaps they would buy an expansion of the band. This could be tried if an individual or group would petition the FCC to expand the Tech privileges to, say, 144.5 through 148 MHz. This would still leave 500 kHz for the higher class licensees, which is far more than adequate for the amount of activity on the band at present . . . or that has been on the band during the last 20 years . . . or that we can envison on the band in the foreseeable future unless some development comes along which is not imagined yet.

The progress of FM would be eased with such an expansion. What do *you* think?

Ideas

The Morse Memory unit in the December issue got us to thinking, when this is used for repeater ID, all that storage capacity is not really needed . . . so why not use some of the left over IC function for a timing circuit or two? Most repeaters need a timer to permit a one to three second lag for the squelch tail and another to time the repeater off the air if a continuous signal comes in for three minutes.

And how about someone coming up with a simple LED numerical readout for FM channels which is controlled by the crystal switch? You wouldn't need a counter, just a means of coding the readout when the particular crystal is installed. It would be a lot better than just channel numbers, right? Two numbers for the transmit channel and two for the receive would do it. Well?

220 Repeaters

Little has been done with 220 FM as yet and the pattern of repeater channelization is in a state of flux. I would like to offer the pages of 73 as a forum for discussion of possible channel plans. As a starter you might consult the chart on page 100 of the April issue of 73 which listed the 220 proposed channel frequencies.

One of the deficiencies of the two meter FM development, from my point of view, was the use of the commercial scheme of using just one channel for both transmit and receive, thus enforcing the usual type of radio contact where one person at a time can talk. Duplex, where both parties can talk at once, would be more fun and, unless there are serious problems of available frequencies, would seem beneficial. So naturally I suggest that we give strong consideration to setting up 220 for duplex operation.

If we set up our repeaters on 220 spaced 3 MHz, we should be able to receive while transmitting without any serious problems. Okay for one channel. So I propose that we start at 220.02/223.02 for the first pair, and then run a duplex pair for that repeater on 220.06/223.06. In use we would transmit on 220.02 and receive on 223.06 for one pair and transmit on 220.06 and receive on 223.02 for the second pair, transmitting and receiving simultaneously for full duplex operation. If 220 repeaters proliferate anything like 146 repeaters, the crystal expense could be almost prohibitive, running double that of two meter channels. I suspect that synthesizers will be with us shortly and will provide a low-cost solution to that difficulty.

If you have any experience or educated opinions on repeater channel standards for 220 please consider this a request for your expertise.

Coming Special Issues

We are hard at work on our usual spectacular March Surplus Issue of 73. If you have any last minute surplus conversions (relatively simple ones) this is the time to send them in. And what else would you like to see in a surplus issue? Let me know. I'll try to have the biggest collection of surplus ads I can muster.

April will again be special FM Month. I would appreciate getting as many FM circuits as possible for inclusion in this issue. Please make the circuits as complete as possible so only a little text is required for them. Send in tone code, decode, COR, PL, touchtone, control, timers, identifiers, logging devices, antennas, or whatever you think you might have that others would like to know about and have not seen. I'll have a complete crystal selection chart for all commercial rigs in the issue. And I'll try and bring you a complete rundown on all available FM ham transceivers, amplifiers, and such.

Beyond April we are working hard on special features in later issues on portable and mobile equipment, antennas and towers, VHF/UHF, DX, IC/solid state . . . and plenty etc.

FM Expansion Proposal

The FM channels between 146–147 MHz are pretty well occupied in the New England area and are filling up rapidly in several other population centers. The question that arises is where next?

Since there is no FCC regulation prohibiting the repeating of a Tech licensee into a higher class license segment of the bands providing the licensee of the repeater is appropriately licensed, the expansion of repeater outputs into the 147 MHz range is possible. But where do we put the input?

In practical application, most of the AM and other non-FM activity on two meters occupies the lower half MHz of the 144 and 145 MHz segments of the band. It seems to me that it would be practical for FM repeaters to start using the other half MHz bands, with their input from the 145.5 to 146.0 band and output in the 144.5–145.0 band, separated exactly 1 MHz. Remember that the 600 kHz separation used in the 146 MHz band was a compromise for operators who wanted to transmit on both input and output frequencies (146.34 and 146.94) without having to retune their rig. If you can give up the need

to use the repeater output as a simplex channel you are freed from the 600 kHz restriction.

If we had it all to do over I just wonder if we might not opt for an even wider spacing between input and output so full duplex would be possible? A 2 MHz spacing would permit this and enable us to indulge in a completely different type of contact. Well, I guess it is too late to cry over spilt milk on two meters, but we certainly should keep this lesson in mind when we start populating 220.

What do *you* think?

Proposed FM Repeater Channels

Input	Output
145.50	144.50
145.53	144.53
145.56	144.56
145.59	144.59
145.62	144.62
145.65	144.65
145.68	144.68
145.71	144.71
145.74	144.74
145.77	144.77
145.80	144.80
145.83	144.83
145.86	144.86
145.89	144.89
145.92	144.92
145.95	144.95
145.98	144.98

FM News

C. T. Power, who makes the Tempo amplifiers being marketed by Henry, will be out shortly with a little FM two meter amplifier for under $100 (namely $99.50) which will take the average 10 watt transmitter and boost it to 40 watts out. This should be a popular item since an extra 6 dB from most mobile rigs could extend the range substantially. Their 220 transceiver, announced recently, is seriously back ordered, proving that a U.S. made 220 transceiver at $180 was definitely needed. Their repeater version of the rig should be along soon and we're going to do everything we can to encourage every repeater group in the country to add a 220 MHz repeater to their present setup in the hope that a quick population explosion in that band might tilt the table in our favor when it comes to consideration of the dreaded EIA proposal to carve up that band for the CBers.

As if all that weren't enough, C. T. Power is also hard at work on a 450 MHz transceiver. They already have a beauty of a solid state 450 amplifier which turns 4 watts into 30 watts and sells for $210. If they can keep up with the commercial demand for that one perhaps we will be seeing some on our 450 repeaters. They also have a two meter transceiver and a repeater package well along. The transceiver will have 11 channels plus a vfo and is planned to sell for about $255! 15 watts. The repeater will have its own 12 volt supply and use a car battery in case commercial power is interrupted, with its power supply keeping the battery in full charge.



GATHERINGS

Wheaton Community Radio Amateurs (WCRA) will hold its tenth annual Mid-Winter Swap and Shop on Sunday, Feb. 20 at DuPage County Fair Grounds, Wheaton, Ill.; 8:00 a.m.–5:00 p.m. $1 advance, $1.50 at door. Refreshments and parking. SASE to WCRA, P.O. Box QSL, Wheaton IL 60187 for info.

California

Southern California DX Club plays host to the 23rd annual California DX Conference on January 22 and 23 at the Del Webb Towne House in Fresno. Beginning and experienced DXers are invited to attend. Speakers include 3CØAN, ZA5C, VK9NP, and 3B9DK. Talk, cocktail party, steak dinner, DX breakfast on Sunday are some of the events of the conference. Signal/One CX7A pre-registration prize. Send check for $14.50 to SCDXC Treas. Jack Hollander WB6UDC, 13531 Malena Dr., Tustin CA 92680. Include SASE. Pre-registration ends Jan. 7.

Indiana

The Lake County ARC's nineteenth annual banquet on February 12 will be held at a different location this year. It will be at the Scherwood Club in Schereville, Indiana. Map is on back of the five dollar tickets which can be obtained from Herb Brier W9EGQ, Ticket Chairman, 385 Johnson St., Gary IN 46402, or from other members. No tickets at door.

Arkansas QSO Party

From 2200z Sat. Jan 22 to 0400z Mon. Jan 24. Ark stations score 1 pt per contact times number of States, Provinces and countries worked. Non-Ark stations 5 pts per Ark contact. Stations may be worked once on each band and with each mode. Certificates for highest scorer in each State, Province and foreign country with 100 pts or more. Exchange QSO number and signal report plus State or country. Suggested freqs are 3560, 7060, 14060, 21060, 28060, 3960, 7260, 14300, 21360, 28560; 3735, 7175, 21110. Logs before Feb 21 to North Arkansas Amateur Radio Society, Rt. 1, Green Forest, AR 72638.

Contests

Second World SSTV Contest, sponsored by *cq elettronica magazine*. This contest is to promote increased interest in SSTV as used by radio amateurs. Contest period is Feb. 5, 1972, 1500–2200Z, and Feb. 13, 0700–1400Z. All bands may be used, and the exchange is picture and number of the message.

Two-way contacts score one point (total points is number of individual stations contacted), no extra points for contacting same station on different bands. There is a multiplier of 10 points per continent and 5 points per country (ARRL list). Score is computed by multiplying exchange points times multipliers. All logs to be submitted must contain date, time (GMT), band, call, message numbers sent and received, and points.

Send logs to Prof. Franco Fanti, via A. Dallolio 19, 40139, Bologna, Italy. First prize is a year's subscription to *cq ellettronica*; second and third prizes are 6 month subscriptions. There is a special SWL prize.

The Milliwatt: National Journal of QRPP once again will sponsor a QRPP NET for 1971-72, commencing operation on November 15, 1971. The QRPP NET will utilize the QRP ARC I calling frequencies of 7040 kHz and 14065 kHz. Regular NET times are: 7040 kHz – 0830 EST Wednesday; 14065 kHz – 1100 EST Saturday and 1800 EST Sunday. Procedure: check-ins will call CQ QRPP NET and make contacts individually; there will be no regular NCS, as we will allow conditions and activity to determine operation of the NET. In addition to the regular NET times, stations are requested to monitor the NET frequencies for possible calls at the following times: 7040 kHz – Sunday, Monday and Wednesday at 2100, 2200, and 2300 EST; 14065 – Sunday, Tuesday, and Thursday at 0900 and 1845 EST. Monitoring stations are requested to tune ±2 kHz, and should be reminded that calling stations, running at the milliwatt power level, will probably be weak, and hence rf gains should be turned up. We request stations making contact on the NET to report them to *The Milliwatt* c/o Adrian Weiss, 117 Central St. #F-10, Acton MA 01720.

Also, *The Milliwatt* sponsors two awards for QRP DX operation. One is for low power contact with twenty-five or more countries, and the other is for very low power (under 1W) contacts. For full details, contact Adrian Weiss at the above address and include a SASE, or check a copy of *The Milliwatt*.

Guest Editorial

Wells Chapin W8GI

The introduction to the fiftieth anniversary publication of the Institute of Radio Engineers proceedings started thusly: "The life of a man or organization has been aptly compared to the sequence of lights and shades during one day on earth. In the early morning, long shadows lie to the West as the sun rises. Then these shadows shorten as the day advances until no shadows are visible in the noonday blaze of light. And later, the shadows lengthen as the sunlight wanes, and twilight and night approach."

These words were written during a critical period of the life of two very fine professional organizations, the Institute of Radio Engineers (IRE) and the American Institute of Electrical Engineers (AIEE). Both organizations were facing real problems and both competed in many instances for the same men. The managers of these groups – being professional men – recognized the dynamic changes swarming around them and planned ahead. They could see that both groups were headed for trouble unless something was done. They acted, merged, and formed the present Institute of Electrical Electronics Engineers (IEEE), which is now a very fine, respected and prosperous organization.

Herein lies a parallel – the ARRL is in the shadows of the afternoon and faces the darkness of the night, and the same type of problems that the IRE AIEE faced. It is amazing to look at the parallels. In amateur radio we have CW vs phone, DX vs ragchewers, traffic men vs non-traffic men, one band vs the other, one modulation vs the other, miscellaneous organizations and their separate goals, ad infinitum. Yet all these men are amateurs and should be brothers. Just as the IRE and AIEE did, the ARRL faces many of the same type of problems, including financial difficulties. So what do we do about it?

It is interesting to compare the problems of IRE and AIEE to those of the League and at the same time look at the different approach to their solution. First of all, the IRE put their problems on the table. They were freely admitted and written up in the Proceedings, both pro and con. The Proceedings did a magnificent job of defining the problem, presenting both sides. They did a real management job and followed this up with action and a factual reporting job. When a merger was suggested, they presented the pros and cons and sold the idea. That is why the IEEE is a solid, respected organization. They knew how to keep their members happy; they calmed dissention through the printed word. Why not take a serious look at the IEEE and take advantage of their experience in successfully solving the same sort of problems we amateurs face.

The IEEE now has two magazines for its members. One is very technical, the other is more broad brush and appeals to those who do not care for the highly technical. They have 34 technical groups, each with a different interest, and each have local chapter meetings. Each group has a small paper-type of publication for its members which covers their particular interests. The IEEE has regional and local chapters. According to a 1970 article in their *Spectrum* magazine, the IEEE has 169,059 members, not unlike that of the League numbers or at least what the League numbers should be. They have different classes of memberships, including Fellow Senior Members, Members, and Student Members.

The roster of the IEEE has thousands of amateurs. One famous, highly respected name that appears in the roster is that of our former ARRL president, Mr. George Bailey. In the past the ARRL has had some wonderful, highly respected, very competent men as president – for instance, Herbert Hoover, Jr. Now let's ask why these men resigned the presidency of the ARRL? All you have to do is read the Constitution and by-laws to find the answer. As you read, you find that the president is for all intents and purposes, powerless to act. Therein lies a basic problem. Therefore let's take a look at our antiquated Constitution and by-laws and bring them in tune with the times and give our president some real authority and responsibility. Let's have a paid president who works at the job. Other sections of the Constitution eliminate some real talent, because they prohibit a person to be a director who has an interest in manufacturing of electronic equipment, or a person associated with a radio magazine. There are other sections just as unwieldy and outmoded as these. How about a committee to report on bringing our Constitution and by-laws in tune with the times?

Let's look at a name change to better reflect the purpose we have of selling amateur radio. Then pattern local chapters of amateur radio groups just like the IEEE. For instance, why not call our League the Institute of Amateur Radio, and then instead of a flock of clubs with various names and aims we could have, for instance, the Detroit Chapter of the Institute of Amateur Radio, and under that subhead have the Detroit DX group of the IOAR, the Two Meter group and FM, the CW group, and so forth, and then have Michigan Regional State groups. Here in Detroit we have a social occasion each year for the regional IEEE members. Why not envision all amateur radio groups under one name? A name projects one's aim or purpose. Who knows what the ARRL means but an ARRL member? Let's get public relations conscious and organization conscious. Look at the power of the auto workers and the various other unions. In union there is strength!

Now let's take at look at the League. Only one side of the story appears in QST and that is highly biased. You never read what a director stands for. Even our directors cannot get the other side of the picture printed. Why can't the ARRL lay the problems on the table and then solve them and sell the solution to all – repeat, all – amateurs and not just League members, and at the same time show the importance of all amateurs belonging to the League. It just is not healthy to have dissension in the ranks of the ARRL dividing the approximately 80,000 members. At the same time, we tell 200,000 other non-member amateurs what is good for them, and we supposedly represent their views in the League presentations to the FCC, when in fact they haven't been represented at all and what's worse – they don't know what is going on because they don't get QST and don't even have the chance to read the biased views presented.

Why do we resist change? Those who resist change generally suffer the consequences. While we are sitting around operating as we did fifty years ago, a communications revolution, population explosion, and dramatic world changes are swarming around us. The ARRL seems to doggedly resist change, and in addition sweeps the problems under the carpet when they should be laid out to view. We should ask the help of some of our very competent amateurs who are not League members in solving our problems. Read the *Who's Who of Amateur Radio* and you will find thousands of names that would add prestige to our organization in addition to bringing real talent to revitalize the League.

What ideas do you have? Write your director, demand action, and send a copy to *73*. Let's revitalize amateur radio and make it the healthy, respected entity it used to be.

. . .W8GI

Mr. Chapin has some interesting constructive ideas regarding the League which need airing. 73 welcomes such comments from any reader, pro or con the League and any other matter of vital interest to all amateurs.

NEW PRODUCTS

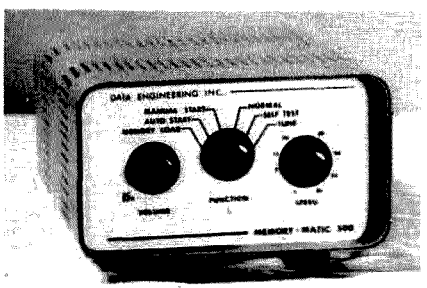
CW KEYER and MORSE MEMORY UNITS

Data Engineering Inc. has come out with a pair of keyers that may just revolutionize the whole keyer field.



The Space-Matic 21 keyer is designed to work with any key or paddle, but in particular with the Data Engineering solid state electronic key. When both dot and dash paddles are touched the keyer alternates dots and dashes. The spacing between dots, dashes, characters and words are automatic and fixed in length, assuring the most beautiful CW you've ever sent.

The keyer has sidetone built in and a reed relay to key the transmitter.



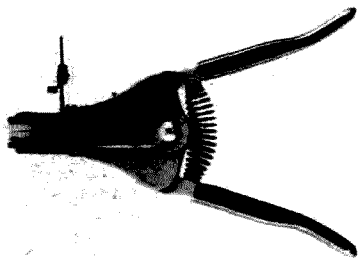
The Memory-Matic 500 has all of the same features of the above plus a 500 bit memory which will handle about 50 characters. Imagine what a difference this can make in a contest! You can put in the signal report, section and date to be sent to each contact automatically, so all you have to add is the call and time by hand and you are on to the next contact.

Two meter repeater owners may like using this for identification, as may remote base users on the VHF and UHF bands.

When you are loading the memory with a CQ call or a contest exchange, a side tone lets you know when the memory is near full by rising in pitch. A steady tone indicates it is full. The message in the memory can be sent back at any time at any speed from 3.5 to 85 wpm. Will we be hearing even sideband stations being identified every ten minutes with a short burst of weak tone from these memories? Will RTTY operators flip one of these in to give the CW identification required?

Prices are very reasonable for these two devices. The Space-Matic 21 keyer is $89.50 and the Memory-Matic 500 is $198.50. Write to *Data Engineering Inc., Box 1245, Springfield VA 22151* for specification sheets.

Automatic Wire Stripper and Cutter



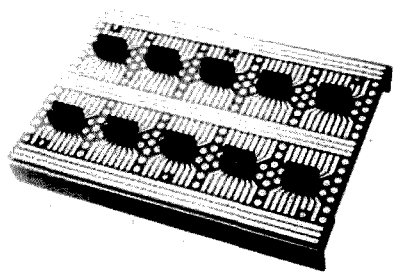
Radio Shack is offering a new Automatic Wire Stripper and Cutter in their line of Archer tools which they say strips #24 to #12 gauge wire perfectly in a second.

To operate the wire stripper you simply insert the wire, squeeze the insulated handles and release. Insulation is removed cleanly and completely without nicking or breaking wire. A strip gauge guides the wire to the correct portion of the blade and assures a uniform stripped length every time.

The Archer Automatic Wire Stripper and Cutter is priced at $4.95.

Archer tools and accessories are available exclusively through Radio Shack's more than 1100 stores in 49 states and Canada, or by mail.

PROTOTYPE BOARDS

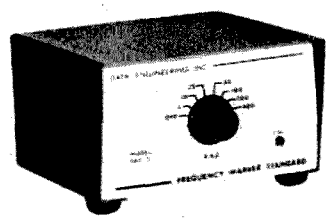


Experimenters, rejoice! Maratron *(Box 777, Dallas TX 75221)* has come up with just what you are looking for. Prototyping boards designed for transistor and IC circuits. They have patterns for 4 lead transistors, DIP IC's, and TO-5 IC's of 8 and 10 leads. Dot patterns available for using discrete components, too. And all boards are reusable. Write and say 73 sent you.

Security Catalog

Amateurs interested in working up a nice little second income could do a lot worse than getting into the security business. There are few offices or stores, or even homes for that matter, where some security system might not be needed. Wouldn't your wife sleep better if your home were protected against intrusion and fire? One of the big problems for anyone wishing to get into this fast-growing field has been one of getting information as to available equipment. *The Mountain West Alarm Supply Co., 4215 North 16th Street, Phoenix AZ 85016* has a free catalog (64 pages) of the latest security gadgets and, armed with this book, you can go into business for yourself. Please mention 73 when you send for that catalog, okay? And please remember where you got the idea to do this when you are rich. Don't be a fair weather friend.

FREQUENCY MARKER DELUXE



100 kHz markers have been around for a long time, but they are inadequate to meet the demands for band edge marking and calibration with today's split up ham bands. How many operators know for sure exactly where the 3825 band edge really is? Or 14275?

Large scale integrated circuits make a low cost (relatively) frequency marker possible today which starts at 400 kHz, splits that to 200 kHz, 100 kHz, 50 . . . 25 . . . 10 . . . and even 5 kHz! Data Engineering Inc. has announced just such a unit and is marketing it for $32.95 complete with built-in battery holder and a five year guarantee. The marker, less cabinet and stuff is available wired, tested and calibrated for $22.95 . . . or even in kit form for a lowly $19.95. It runs from four penlight cells. The uncabineted one should be fine to build into your receiver if you can figure where to borrow a few mils of 6 volts. The square wave output of the marker rings out clearly even above 150 MHz, so it can be used for zeroing in those FM crystals. The calibrate screw driver control on the front panel is for touching it up against WWV.

Spec sheets are available from *Data Engineering, Box 1245, Springfield VA 22151.*

TELL OUR ADVERTISERS YOU SAW IT IN 73!
. . .even if you didn't

More New Products

NEW TONE BURST ENCODERS ARE DIRECT POWERED

The Ross and White Company has announced two new Tone Burst Encoders that are powered directly from FM, 2 meter transceiver power sources in transmitting repeater access signals.

Keyed by closing the transmitter microphone switch from the 12 volt dc keyed source, the Encoder generates a half second tone burst which modulates the transceiver and automatically activates the tone allowing activation of tone access.

Two models are available. The two tone model TE-2 sells for $39.95 and the five tone model sells for $49.95 postage paid. Both are sold on a 10 day trial, money back guarantee basis.

Installation of the TE-2 and TE-5 is relatively simple using the complete instructions provided for your make and model of transceiver. The battery powered models will continue to be available for hams preferring that arrangement.

For full data including specifications, write direct to the *Ross and White Company, 50 West Dundee Road, Wheeling IL 60090.*

Motorola's HEP Introduces LEDs

Light emitting diodes are now available to the hobbyist-experimenter through Motorola's HEP semiconductor line, with the introduction of four new light-emitting diodes, three visible red and one infrared device (P2000, P2001, P2003 and P2002). These devices are ideal for digital clocks, frequency counters burglar alrms, panel lights and on/off indicators. The devices are available now at authorized HEP suppliers nationwide.

NEW 2M FM TRANSCEIVER



A built-in tone burst encoder is featured in the new Ross and White 2 meter FM transceiver Model RW-Bnd now available from the Ross & White Co., Electronics, 50 West Dundee Rd., Wheeling IL 60090. The built-in tone burst encoder provides quick and easy access into tone activated repeaters now becoming common across the country. Three tone selections are provided. All tones are factory preset to commonly used frequencies but can be easily reset.

A front panel power selector switch lets you choose power output for 0.1, 1.0, and 10W. Another switch allows 12 channel capability. For those who do not wish the tone burst function, the rig is available without it, and the encoder may be added later as an accessory. The RW-Bnd comes with mike, mounting bracket, and four channel combinations installed.

MEMORY IC'S

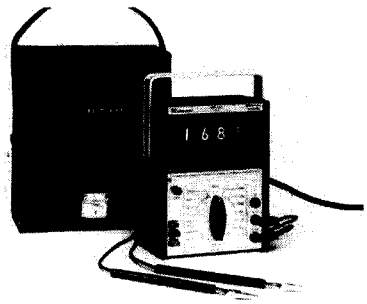
Repeater control and CW keyers with pre-recorded message circuits are advised to investigate Intel Corp.'s sixty-four bit memory and binary decoder IC's. These are random access or addressable memories. Series 3101-3104 memory and 3205/3404 decoders; info via *Intel, 3065 Bowers Ave., Santa Clara CA 95051.*

NEW SWL RECEIVER



Heath of Benton Harbor has come up with a new SWL receiver, the SW-717. It covers BC through 30 MHz, has a built-in speaker, and tunable bfo to copy CW or SSB. It looks good for the Novice or as a second receiver for the occasional SWL in all of us. Write to *Heath* in *Benton Harbor MI 49022.*

DIGITAL MULTIMETER



Triplett, after all these years of being first in the meter biz, has come out with a digital v-o-m! Billed as a 2¾ digit meter, the last figure tells you whether the number is above or below five. The price is 2¾ centibucks, which makes it a little high for the average ham shack and probably of more interest for lab or service shop use where the time saved by using this meter could eventually pay for it. *Triplett, Bluffton OH 45817* will be delighted to tell you all about it and ecstatic if you buy a few dozen.

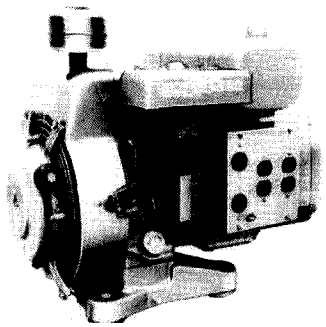
1W FM TRANSMITTER

Avcom has come out with just the thing for those who want to go FM but cannot afford to. The FM-201 is a miniature 1W transmitter that can be mounted inside any of the high-band monitor receivers to make an instant transceiver for under $200. Or if walkie-talkie is your bag, any of the portable high-band receivers and this rig will make a hand-held unit for under $100. Multi-channel operation is possible; and with the 10W power amplifier, a handy walkie and mobile combination is easily within the reach of most hams' finances. Contact *Avcom at P.O. Box 29153, Columbus OH 43229.*

RECTIFIER INFORMATION

Hams working in RTTY, FM, and those experimenting with logic may find a new Motorola silicon controlled rectifier useful in low power switching, detection and sensing, and control functions. These units draw very little current from the circuit and are less than one tenth inch in diameter. Write to the *Technical Information Center, Motorola, Inc., Semiconductor Products Div., Box 20924, Phoenix AZ 85036* and ask for info on their Micro-T MCR051 through 054 series.

3 kW Generator



A new air-cooled, 3 kW gasoline–driven electric generating set was announced by the Onan Corporation.

Available in both manual start and remote start models, the new model 3.0NB provides 3 kW of 120/240V, 60 Hz, single-phase, 4-wire electric power at 1800 rpm. All models are reconnectible to deliver rated output at three different voltages 120V, 2-wire; 240V, 2-wire, or 120/240V, 3-wire – permitting the user to employ equipment of different voltage requirements through a simple wiring change.

An important feature of Onan's new Model 3.0NB is the single-manufacturer construction throughout. The air-cooled engine, revolving armature generator and (when used as a standby unit) the matching automatic load transfer control are all designed, built and tested by Onan to operate together as a single-integrated system. *Onan Division of Onan Corporation, 1400 73rd Avenue, N.E., Minneapolis MN 55432.*



What with the emphasis on upgrading one's license due to incentive licensing structure, it behooves the amateur to learn, not memorize, his electrical theory. When test time comes and the Man is staring at you and the temperature in the room creeps to 120°, your memory can fail,but not if you really know what you are talking about. You can read books or attend classes, but there is a lot to be said for practical experience, too.

One way to get this experience is to operate your station, but twisting knobs and watching meters bob around only goes so far. If you want to know how to operate your rig, read the instruction manual which should have come with it. If you want to know how your rig operates, read the instruction manual section entitled "Theory of Operation." It's easy to quickly read a few paragraphs, but try this way instead. It will take longer, but it is better for anyone who wants to learn.

Disconnect the rig and open it up, but leave the ground wire connected. Use all safety precautions. Now with the manual in front of you, read the section slowly and where it says plate tank coil, find it in the rig and touch it. Examine how it is placed. Is it parallel to any other coils, or perpendicular? Is it shielded or in the open? Notice parts placement in the rig and also how they are placed on the schematic. To become familiar with these pictures will make the FCC tests easier and also you will be able to read any of the amateur magazines with greater enjoyment. Also look for the different components mentioned in the theory section of the manual. If C6 is a bypass capacitor, what is it bypassing? What is bypassing? Why bypass at all? Any terms that are unfamiliar or vague should be looked up in a handbook or other references. Even after looking at your own rig a few times and perhaps a few others, and then reading the pages of this or other magazines, you might recognize a section of the schematic. It may be an oscillator stage, or an i-f. In time, the different sections become connected in your mind and you will know what the author has in mind. Of course, you should read his comments about the theory of operation of his unit, also.

For many – Novices and Generals alike – this can open a whole new dimension in our hobby. An awareness of what takes place behind the brushed aluminum panel is valuable not only for assistance in passing the next higher ticket, but it adds enjoyment and comprehension of the journals. Never overlook construction articles or articles of electrical theory. These are what the hobby is made of. As you become more familiar with the theory, you might want to try a small construction project. Nothing fancy, perhaps a field strength meter (meter, diode, and a choke). When it turns out right, the next project might be a little more complicated, like a one transistor code practice oscillator. Maybe you can even design one yourself. Then maybe a small QRP transmitter. Speaking for myself, I was a ham for over ten years and never built more than two kits. Then, about a year ago, I built an antenna. Then a CPO and monitor. Then a field strength meter. Then a QRP transmitter. There really is nothing that can compare with the feeling of satisfaction that comes from communicating with someone on a rig that you built yourself. It is a warm glow that spreads up from the gut to a dizzy sensation in the head. It happened to me on my first QSO with a 100 mW transmitter. I'm getting the bug to build and I know what I'm building, and why it works.

When you face the examiner the next time, you'll walk in with confidence, knowing you have the knowledge at your fingertips. After all, you've been working with this material for some time and you have made electronics a part of your life, not just another pastime.

...KINUN

LETTERS

ou goons don't ever proofr
l asy
bunch of rocks
you ignored my comments in
I insist that you print ev

I have finally given in to my carnal desires and am begging for a chance to read 30 untouched issues of 73. I had to decide whether I wanted the Gunsmoke or the Extra Class Study Guide. I guess I like fun more than work. Seriously, I used the Advanced Class Study Guide and passed with only a week of study. This fact did not change my views on the horrible nightmare of incentive licensing, however.

As I now have a new call, W7INH, I feel like an old timer and can now give out my opinions with the rest of them. WB9FIN in the Oct. issue mentioned only a few of the rotten acts which take place on 20 meters. I used to think 40 AM in the early sixties was mayhem. I cannot even speculate why hams' manners have deteriorated so much lately. I could not afford SSB equipment and was inactive until recently and the change in operating habits is startling, to say the least.

Everyone seems to promote their own interests these days, so I have a few proposals':

1. I cannot afford a tower or a beam as I am now paying back all my law school debts so all beams and quads should be outlawed.
2. My transceiver only runs 200 watts PEP so that should be the power limit.
3. I did not notice the code "hump" of ten words per minute but I am rusty now so the 20 wpm requirement for the Extra must go.
4. I am too dumb and too busy to homebrew my equipment so all questions on the exams concerning theory except those on antennas and feed lines should be removed. (For some reason I understand SWR.)
5. As I just finished three years of law school, most questions on the exam should be from pertinent FCC and international regulations. I think I could pass the Extra exam and be on someone's honor roll if this were done.

Steve Guelde W7INH ex K8RSX
Cheyenne WY

As a professional language educator, I want to congratulate Gilbert Ford on his excellent article, "Say Coo, Say Coo, Day Eckees." (September, Page 107). It is well written, good content-wise, and – hopefully – useful. May I, too, encourage amateurs to try even a few words of another language. It pays handsomely in friendship if you'll just try.

Philip D. Smith W3DZR
West Chester State College PA

This is a comment and suggestion about your proposed "handbook" format. It is basically an exellent idea. It seems to me that many advertisements are almost useless. They say someone is selling such and such, give a price and address and perhaps a sales pitch. On the other hand I suspect most hams and experimenters have some difficulty obtaining technical data on components. Do you suppose that the component manufacturers or suppliers could be persuaded to devote some of their advertising space to data sheet type stuff. For example, the ad in the October issue listing a bunch of semiconductors is useful to someone shopping around for the cheapest price on,

Continued on page 10

LETTERS CONT.

say, a FET for a VHF front end, but I would rather see, and might sooner be tempted to buy, an ad with data on a single device or family, with prices and an address at the end.

Bill Rutiser
Brandywine MD

Good idea!

DEPARTMENT OF AMPLIFICATION

I want to thank you for the nice write-up you did on our alarm. One thing you didn't mention in the article which is important, is that our system (when used with your car's horn) causes the horn to pulsate in a "beep-beep-beep" fashion so that it cannot be mistaken for a stuck horn. It may seem like a small detail, but we feel it's a very important one.

Walter Scudder Jr.
Technical Product Development. Co.
Nutley NJ.

I just finished reading Gilbert Ford's article in the November issue, "Let's Revise the Morse Code." He makes a very good case, but we all know it will never happen. However, some rather interesting conclusions can be drawn from Figures 2 and 3 (bit length of letters and frequency of occurrence). Just nine letters (E-T-I-A-N-S-R-D-H) constitute 65% of all letters used according to the "frequency of occurrence" (Fig.3). These same letters have a bit length of 10 or less. Mr. Ford makes the valid point that the "momentary speed burst effect' is the ultimate limiting factor in anyone's ability to copy code. Any ham who can copy 13 wpm already has the ability to copy these nine letters at better than 20 wpm. It seems reasonable that every ham could copy over 20 wpm by concentrating practice on these nine letters until he could copy these at an average speed of 35 to 40 wpm.

Now, if we could get our friends at Newington to include 15 minutes of E-T-I-A-N-S-R-D-H at 40 wpm as a standard part of daily code practice we would soon all have "Extra" class licenses and the need for confusing "sub bands" would vanish!

Robert B. Baker WA7NCT
Billings MT

That Heathkit 15 MHz counter took me 5 hours at the most, and worked first time. Now my pupils won't believe any other kind of frequency meter. I'm not an experienced assembler – I'm a Physics teacher; I pick up the iron when I feel in need of therapy.

Bill Jarvis GM8APX, GM6AGF/T
Dall School
Perthshire, Scotland

Re the Washington tower case, page 5 October issue, I have sent along a modest amount to help in the case. It is important to all of us to cooperate in these tower cases as they arise, in order to establish as many favorable legal precedents as possible. They will be needed in the future, as public opinion against towers and poles increases. The power and telephone companies are already under increasing pressure to put their distribution lines underground. It is anticipated that cable TV will, in the near future, expand very rapidly, mostly because of the extended service it offers – 20 channels are quite likely. In time, as sets and antennas wear out, people will switch to cable TV. Eventually, the forests of TV antennas will disappear, and the pressure against the ham antenna will mount even more. (On the plus side, hopefully, the TVI problem will be eased.) Looking into the distant future, and barring catastrophe such as nuclear war, the TV frequencies will be commandeered for mobile use. Probably all non-mobile radio uses will be banned. But by that time, the hams' spectrum space will long since have been eroded.

John P. Kinzer KV4FY
Christiansted, St. Croix, USVI 00820

Thought you might be interested to know that my article, "Amateur Radio and the Handicapped," in the November issue was very well received.

I received personal letters from other disabled and non-disabled hams in California, Minnesota, and Arkansas and many comments from local amateurs.

It is not too often that articles like this or information for disabled operators appears in magazines like 73. I wonder how many amateurs know of the Handi-Ham System in Minnesota where amateur equipment is loaned free to those who need it, or the Handicap Net? How much of the transistorized and IC logic can be used for the blind, deaf, and physically disabled? There could be many interesting and quite worthwhile articles written in this area.

Ron Perry WA2CGA
Trustee W3CVT

Having just read the plight of WN30SI in November Letters section, I decided I'd better not take *any* chances. Renew my subscription, take my money, and leave me in peace. (Could you get word to the Subscription Department about returning the rest of my family and my receiver, please?)

All kidding aside, I really enjoy 73. I just hate to see you dump it on some unsuspecting person. From where I sit, the reason 73 is successful (and it is) is that none of the people connected with 73 have lost the "common touch." Congratulations on that and the best of luck in your new endeavors.

James Morrison WN9FRP
Geneva IL.

Rather than to fight non-business CB over 220 MHz, a much more practical solution is to establish a "Communicator" class ham – no test, or modest test, crystal control on assigned frequency, modest power, transmitter adjustment by other class ham or 2nd Phone. Rather than to open a Pandora's Box – to my mind it will stimulate other class ham growth, provide commercial incentives now lacking on 220, stimulate observance of radio regulation rather than to make the citizen a criminal as is now the case by multitudinous regulations, low power, and skip band temptation – certainly a hot potato for the FCC – with neither enough manpower or money to enforce the regulations.

We as hams need more of us when it comes to international frequency conventions, e.g. 1 or 2 million rather than ¼ million to provide public service in time of trouble or disaster.

John K. Lassig W5IOV
Houston TX.

I just received my long awaited November issue of 73, but, alas!! What happened to the mobile theft alarm mentioned under "FM" on the cover? Did I not read the fine print?

John H. Bauer W4AWM
Arlington VA.

Someone stole it.

Sorry to have neglected to renew my subscription. Certainly would not want to be without 73, it's tops. At my age (75) discretion may be the better part of valor, so a 1 year renewal will suffice. Have been hamming since 1911 and still enjoying it immensely with the help of 73. Long may it wave.

Edward J. Gallagher WIDD
Quincy MA.

FM PRO AND CON

I have received your information that my 73 magazine subscription ran out. Thanks. I received all issues and thanks on that. You run too much on your pet FM, FM Repeaters, and that cuss hog talk junk. You call it sideband. I would not have any of such junk in my shack. Only two issues of 73 had any ham dope on AM.

When you publish a lot of AM Trans. construction then I will sure subscribe.

Geo. Ball 9BFU
Omaha NB

I know you want to retire, but I must say it is a great relief to have you back at the helm of 73 once again. Now perhaps we can get out of the FM rut. Not that I'm not interested in FM, but too much of one thing bores me to death. I'm confident that 73 will continue to receive periodic renewal checks from this QTH. Although one of your subscribers from issue #1, I must say I nearly jumped ship this year.

Hopefully your annual surplus issue will once again have articles about surplus in it! Hopefully they will be written by those superstars of 73 such as Roy Pafenberg and LeRoy May. Ah, those were the good old days . . articles about RTTY, SSB, CW, antennas, new fangled domaflotchies and old circuits . . . and an occasional article about FM. Bring 'em back, Wayne.

Kenneth D. Grimm K5KBH/4
Sweet Briar VA

FM? What is that?

In regard to WA1LOT letter in Nov. 1971 issue let me say I agree with him fully. I would like to see a little less FM – more Bob Manning – and more YL candid shots.

Greg Bodker WN8IZM

While we have had hundreds upon hundreds of letters from readers who are having the time of their life as a result of reading about it in 73, we have yet to get a letter from anyone who has said we mislead them about the fun to be had on FM. We're with you on more Manning and more girls . . . heh, heh.

I wrote the article appearing on page 63 of the November issue of 73. Several persons have asked me, on the air, about a deletion on page 65 of the article. You might want to add an addenda in a future issue to the effect that on page 65 of Nov. issue, on the 7th line down from the top of the right colum, the addition of: *5 percent* to the right of the plus/minus sign.

The line should read, *"May 1968 QST but I found that a ±5%"*

Jim Talens K3MNJ
Philadelphia PA

Some time ago I promised a group of people that I would put together some information on a series of very economical decade counting/display modules. I didn't get the job done until quite recently, and by now the IC price war has made most of the information obsolete. I went ahead and printed the stuff anyway, partly just to make good on an old promise and partly because there may be some residual value for general education even if the circuits are now uneconomical to build.

As you are in that business, you will know it was no more expensive, once the printer was tooled up, to produce 1000 copies rather than the few I needed, and the net result is that I am swamped with excess copies of this publication, grandiosely entitled *Application Note #1*

If any of your readers would like a copy for whatever use they can make of it – I'm ready to send out copies upon receipt of a (preferably large) SASE. It seems necessary to ask that any respondents refer to this letter so I'll be sure to know what they want . . . every now and then I get a SASE with no indication of just what it is that the sender would like stuffed in.

T. R. Jackson W1DMU
Box 1, Corinth VT 05039

Looks good, TR, better print another thousand.

It is amazing to see that a manufacturer has come out with a rig for 220 to 225 MHz. Some 15 years ago I wrote to various companies who made VHF gear if they might build a rig for this band. They all said there was no demand for them. I say there's no more demand now either. Who the hell do they think they're kidding.

This only to make it easy for citizen banders if and when FCC approves or disapproves.

I know that you along with your enemy CQ are strictly for CB and a traitor to amateur radio. The subscription I get of 73 magazine, I received as a gift. I damned sure would not pay for it, or CQ magazine. QST is for amateurs and ARRL represents us. We would never have lost 11 meters except for you traitors.

M. Schreck Jr.
Kearny NJ

The unparalleled success of 2m FM has increased amateur interest in 220 tremendously and the use of that band is being held back only by the scarcity of equipment available. The recently announced C.T. Power transceiver for 220 at only $180 has started thousands of amateurs to thinking seriously about this band. Their upcoming repeater for that band could well be installed by many or even most of the 2m repeater groups, thereby providing countrywide 220 communication.

Your faith in ARRL is touching. But who, exactly, did put up a battle to save 11m? Was it ARRL? Or was it Wayne Green, then editor of CQ? Please do go to the trouble to ask any old timer who was there . . . anyone. Now, about CB, I can understand why CQ might be pushing for CB since their S-9 CB magazine is the keystone of their publishing empire, but what explains any interest in CB on my part?

The EIA 220 proposal (see March 73 for complete details) is extremely well financed and could easily go through, thus permanently taking away a good part of our band. My proposal seems like a good compromise and gives us an alternative. Remember that EIA has a strong Washington LOBBY and amateur radio has NO Washington lobby at all.

I note in your last issue that you have been getting a bit of backlash on the amount of FM info you have been running. I am not particularly interested in FM as yet but I rather enjoy reading up on what the gang is doing on a new facet of ham radio. At least it makes more interesting reading than "Station Activities" in QST!

Speaking of new facets of ham radio, I saw some *color pictures* that Bill DeWitt W2DD had sent and received by slow scan TV on 14mc. He used a field sequential system much like the old CBS system with six frames of each color. A story like that ought to jar some of the boys who figure that the state of the art has gotten away past the average ham.

Edson B. Snow W2UN
Rochester NY

Thank you, *thank you* for returning the 73 newspages to the horizontal where they can be read without tearing the magazine apart and incurring serious migraine. Usually interesting material was becoming quite a chore to read. As an inveterate article filer, I also appreciate your new system of beginning articles on a right-hand page – please continue.

Louise Frankenberg WA3LEQ
Pasadena MD.

I will probably be going to the University of North Carolina at Chapel Hill. Please print a request for me in the letters column for a ham to room with on campus. Thanks very much and keep up the good work.

Donald Lee Curtis WN4TMU
22 Craven St.
Asheville NC 28006

Thanks for the reader service and the large, easy-to-read print. Incidentally you discontinued the "sideways" printing just in time to restore my sanity and lower my blood pressure. I don't like C.Q. and QST print is too small, so I'm depending on 73.

Arthur Ideker W5CAM
Pine Bluff AR.

How about a complete Novice station – maybe in several 73 articles or perhaps a small booklet to follow the Study Guide? Have been building QST's QRP Rig myself, but wouldn't it be fun to build something in a complete package aimed directly at the young Novice? Maybe something that could be used as a club project. I'd be the first.

D. K. Howard
155 Crescent St.
East Bridgewater MA 02333

Let's hear from some builders about this. A club project is a great way to involve Novices.

How come you had nothing on the story behind the cover of Nov. '71 issue? Most hams (all single like me and most married) appreciate the finer things in life and wish to enjoy these pleasures to the fullest! FB on the mag. too.

Russ Kinner WA8ZID
Toledo OH

Many thanks for a good year's reading. Best regards to all at 73 and keep up the good work.

Doug ZL2AWF
Petone NZ

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agencydiscount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

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We cannot check into each advertiser, so Caveat Emptor. . .

SB200 HEATHKIT kilowatt linear amplifier $150. 415-593-7369. W6KJG, M. Harp, 1120 Furlong St., Belmont CA 94002.

SELL: Heath Transmitter HX-10, Heath Linear Amplifer HA-10, manuals, extra crystals, Dowkey relay, package $300.00, firm. Mint condition, pre-wired, no mods. Bill Robinson, 1640 Wandering Drive, Monterey Park CA 91754.

VHF-FM FREQUENCY DECALS most used frequencies. Peel off & stick on. $1.00 postpaid. Check or money order. Electronic Systems, Inc., P.O. Box 11208, 1518 Gregg St., Columbia SC 29211.

RADIO-TV SHOP SELL. Retirement. All instruments, parts, hand tools, Sams Fotofacts, books, Caddy I-Com & 2-way. Have names – Simpson, Precision, Sprague, Seco, Sencore, Jackson, Paco. Check VA for funding. BARGAIN. Must sell before MAY 72. FONE: 814-652-5126 day only. Dick Myers, 122 W. Main St., Everett PA 15537.

CHANGE THE CODE? Sell your old (very old) wireless code gear to David Serette, 226 Walton St., Portland ME 04103.

SACRIFICE SALE – Simpson FM xceiver, like new, $210 includes shipping. College expenses force sale. T. McLaughlin WB4NEX, College Box 622, North Manchester IN 46962.

WANTED – Collins 30S1 Amplifier. State condition. Sell or trade BC-348, RAL-7 complete. Call or write WB5EVN, Herschel P. McCullough, 4300 Bryn Mawr, Dallas TX 75225. 214-691-3338.

COLOR ORGAN KITS $7.50. IC Power Supply Kit $2. IC's $.25. Computer Grade Electrolytic Capacitors $.35. XMTR Transistor TRW PF3690 $1. Used Variacs. Nuvistors. Catalog. Murphy, 204 Roslyn Ave., Carle Place NY 11514.

SELL: HX-10, $180.00; HQ-170C, $150.00; Speaker, $20.00; Package $330.00. Kilowatt linear, $100.00; Supply, $85.00; Package $145.00. M. C. Mayerl, 312 S. LaFayette, Shawano WI 54166.

FOR SALE – Back issues of 73, QST, and CW. Limited Supply. Jan. 61, Dec. 63, June 66, July 66 issues of 73, 50 dollars each or all 4 for $175. Only 4 left. For others send SASE for details. WB9HUC Gary Sima, Rt. 3, Box 85, Lake Geneva WI 53147.

URGENTLY NEEDED: Equipment for independent missionary support net to handle messages for 30 Bible Translators in Liberia, West Africa. Need: Tower, 70 ft. or more, linear-SSB-220 or similar, 15/20 meter quad or beam. Donated equipment most welcome or send absolute lowest price. Also need Novice and other used equipment to prepare translators before they go to the tribes. We are interested in any extra equipment you have – even on loan basis – will pay shipping. Please help. Ambassadors For Christ Net, Box 366, Concordia Seminary, Springfield IL 62702.

ELIGIBLE VETERANS build and keep a 25-inch Heath solid state color TV as part of a Bell & Howell (DeVRY) home study course. GI-bill pays 100% of the course and kits costs. Contact Bill Welsh (W6DDB), 234 S. Orchard, Burbank CA 91506.

ALMOST FREE. Taped code lessons. Beginners to 5 wpm. Refundable deposit on tapes, $1.00 for postage. Tomlinson College Radio Club, 3637 West Grandview, Tacoma WA 98466.

2-METER FM IC-20. Brand new, solid state, 12 channel, Xtaled for four, 1 & 10 watts, module construction. With mike, m-mount, & cables. $225; K7NHE, 15112 SE 44th Bellevue WA 98006.

ROCHESTER, N.Y. is again Hamfest, VHF meet and flea market headquarters for the largest event in the northeast, May 13th. Write WNY Hamfest, Box 1388, Rochester, N.Y. 14603.

FCC "TESTS-ANSWERS" . . . Original exam manual for First and Second Class License – plus – "Self-Study Ability Test." Proven! Satisfaction Guaranteed. Command, Box 26348-S, San Francisco CA 94126.

21ST ANNUAL DAYTON HAMVENTION will be held on April 22, 1972 at Wampler's Dayton Hara Arena. Technical sessions, Exhibits, Hidden transmitter hunt, Flea market and special program for the XYL. For information write Dayton Hamvention, Dept. 7, Box 44, Dayton OH 45401.

TR-108, immaculate with ac dc power cords; also 2 crystals included. Offer. WA9BYR, 627 Dundee Ave., Barrington IL 60010.



AWARDS

The Rhein Ruhr DX Association (RRDXA) will issue an award to all hams and swl's who can confirm contact with one of their 100-plus members after Jan. 1, 1967 according to the following rules: First QSO with a member counts one point, another point for working him in a different mode (CW or SSB). A member can be worked as often as possible during a contest, and contest QSO's count two points. Three classes of awards are provided: Class I, 100 points, SSB and CW mixed; Class II, 75 points, CW; Class III, 50 points, SSB. Send your application (no QSL's) with 10 IRC's or equivalent of DM5,– to RRDXA-Award-Manager, DJ9NW, Bernd Jurgens, D-5604Neviges, Schutzenstr. 11, West Germany.

The city of St. Louis, MO claims the distinction of being number one for hams on DXCC Honor Roll. They are: WØDU-340, WØSYK-341, WØCJZ-338, WØPGI-338, WØKF-332, WØLWG-332, WØBMQ-332, WØBN-325, WØNVZ-331, WØAUB-324, and WØBK-325. This is a total of 3,652 countries. Any challengers?

QSL's for FØUG, HB9XID, HBØXID, 3AØFN, WA4WME/LX, DL4VA; all handled by DI4VA, Vandergrift, MATCOM-DSO, APO NY 09052.

ELEPHANT hide Leather. Keycase $2; Billfold $7; Pocket Notecase $10. All three – only $15. Beautiful gifts. Money back if not satisfied. Write ZE7JV, P.O. Box 23, Cranborne, Rhodesia.

CANADIANS, Japanese gear. LOW, LOW prices. Free catalogue and information. Glenwood Trading Co., Dept. A, 4819 Skyline Dr., North Vancouver, B.C.

2 CRYSTAL FILTERS – F.M. Filter, 10.7 MHz, 6 dB BW = 13 kHz, SSB Filter 1650 kHz LSB 6 dB BW = 2.6 kHz. $25.00 ea. Paul Ramsden W1MUL, 3 Daniel Webster Dr., Hudson NH 03060.

CASH FOR PC BOARD. All types of copper laminate wanted, 20 pounds or more. Bob Miller, WA8KGE, 2264 Welch Drive, Stevensonville MI 49127.

Don Royer WA6PIR
16387 Mandalay Drive
Encino CA 91316



RTTY ART MADE EASY

"Peace Through Victory," originated for RTTY by Don WA6PIR, art by XYL Maxine.

Have you ever wished that you could make some of that RTTY art that you may have printed? Well, so did I at one time. It is a great deal easier than you might think.

We (the XYL Maxine and I) have found that there is much basic art work available from which RTTY pictures may be made. Cartoons, the comic strips, post cards, magazines, newspapers, centerfolds and photographs may all serve as bases for pictures. While these may not be the right size, an inexpensive child's pantagraph may be used to enlarge or reduce them. A portrait of Washington was made from the etching on the dollar bill. While it is not that important, if you have a little sketching talent, that will also help (or enlist your wife and friends as I did).

Having decided on the subject and having the basic art work the right size, run about four feet of paper out of your printer. Use the center portion of the paper for your sketch or carefully tape or glue (white glue works well) the drawing or photo to the paper. Trim the edges so that all is still the same width as originally. Now take out the paper from your printer and insert the four-foot sheet with the sketch on it so that it will be presented to you as it rolls through the machine. Carefully align the edges of the paper on the platen. Use your line feed to bring the top of the sketch into view. With a little practice, you will be able to tell just where any character will strike the paper.



"Hiram, a Bassett Hound Dawg," originated by Don WA6PIR, art by XYL Maxine.



"Fang, A Siamese Pussy Cat," originated by Don WA6PIR, art by XYL Maxine.

You are now ready to overtype the sketch, punching a tape as you go.

We have found that a small selection of characters is all that is really needed to produce either outlined or shaded pictures. While you may not agree with our selection, study the letters and other characters to learn their individual densities. For example, the M and W are the darkest, followed by the H or X and then by the I. Thereafter, you can use the upshifted characters such as the : or ; followed by the " or - or . and the like, depending upon where you want the print to fall. In this way, you may add the shading that you desire or leave certain areas blank like this:

MMHMHHIHII:I::.:... ...:.::I:IHIHHMHMM

going from dark to light and back to dark again. Keep up this process over the entire sketch. Remove the four-foot paper with the sketch from your printer and reinsert your paper stock. Now play out the tape that you have made and see what you have. You will probably be pleasantly surprised. From this point on, we generally take a red pen and indicate on the print where additions, corrections and any changes are to be made and rerun the tape (having folded the marked-up print and following it line by line, using the paper holder and line guide on the printer) to make the corrections, making a new tape at the same time. In most instances, we can now come up with a pretty good picture with a series of five or six corrected tapes.

When overtyping the sketch, it helps to have a strong light directed on the sketch in your machine. This is particularly true if the contrast of the sketch is poor, as it may be in color photos. Also, as you will not be able to see the part of the sketch below the ribbon, we usually take a pencil and outline the areas where the shading will change from one density to another. This way you may be able to get a more complete picture the first time through. While we do not do this, some of the guys have found it helps to make Xerox prints of the original sketches



"Miss Santa," believed to be by WA9CCP, obtained from W9PRO and relayed by WA6PIR.

or photos and to use those for the overtyping, as they eliminate some shading and provide a black and white sketch from which to work. Keep the detail of the original art work as large as you can and don't be afraid to experiment with different letters and techniques. Do clean up the tapes – we generally do this during the first run-through after the overtyping is finished to remove the extra characters and corrections made during the typing. To give you some idea of the time required to complete the pictures, we put in about 20 hours for one of the long playmates that run 30 minutes or so. Most of this is in making the corrections while rerunning the tape. Even after they are apparently finished, we hang them across the room to see how they will look from a distance and then make the final tape with the finishing touches.

Many of the machines in use today have non-overline features so we have quit using overlining. Stay within a 73 character line. Start and end the tape with a series of letters, a couple of carriage returns and about ten line feeds, as this will help the other guy if he is making a reperf tape at his end. Also, keep in mind those who have machines that downshift on space as well as those that do not do so. If you are upshifted and then space and wish another upshifted character, put in another figures character. Of course, the same applies when you want a letter following a space after an upshifted character. At the start of each line, we generally use two carriage returns, the line feed and two letters or figures depending upon how the line starts, to help ensure that the old and tired machines have time to get to the start of a new line. Again, make your tapes as short as possible by taking out any unneeded characters, extra letters, upshifts followed by downshifts and things like extra spaces or downshifts at the end of a line. Above all, be sure to put your credit line at the end, with the hope that others will follow your lead and keep it there.

So if RTTY pictures are your bag, how about trying your hand and making a few? We will not only be pleased to receive them but the eyes here are about to give out!!

. . .WA6PIR

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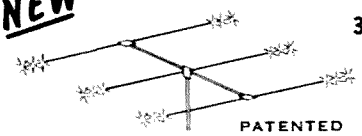
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3 ELEMENTS 10-15-20 METERS

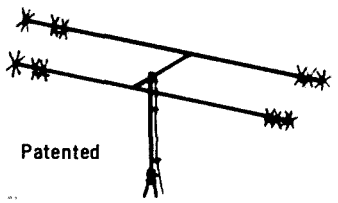


PATENTED

Bands	10-15-20 Meters
Power Rating	1400 Watts P. E. P.
Total Boom Length	11′
Turning Radius	7′-10″
Total Weight	23 lbs.
Single Feed Line	52 ohm
SWR at Resonance	1.5 to 1.0 max.

The features of the popular B-24 plus the new RK-3 reflector kit make a unique 3 element combination. Choose the combination or add the RK-3 to your present B-24 and enjoy the improved gain and front to back.

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Patented

Bands	6-10-15-20 Meters
Power Rating	1400 Watts P.E.P.
El. Length	11′
Turn. Radius	7′
Total Weight	13 lbs.
Single Feed Line	52 ohm
SWR at Resonance	1.5 to 1.0 max.

6-10-15-20 METERS

The time proven B-24 4-Band antenna combines maximum efficiency and compact design to provide an excellent antenna where space is a factor. New end loading for maximum radiation efficiency. No center loading.

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Needs no ground plane radials. Full electrical ½ wave on each band. Excellent quality construction. Mount with inexpensive TV hardware. Patented.

Power Rating	1400 Watts P.E.P.
Total Weight	6 lbs.
Height	11′
Single Feed Line	52 ohm
SWR at Resonance	1.5 to 1.0 max.



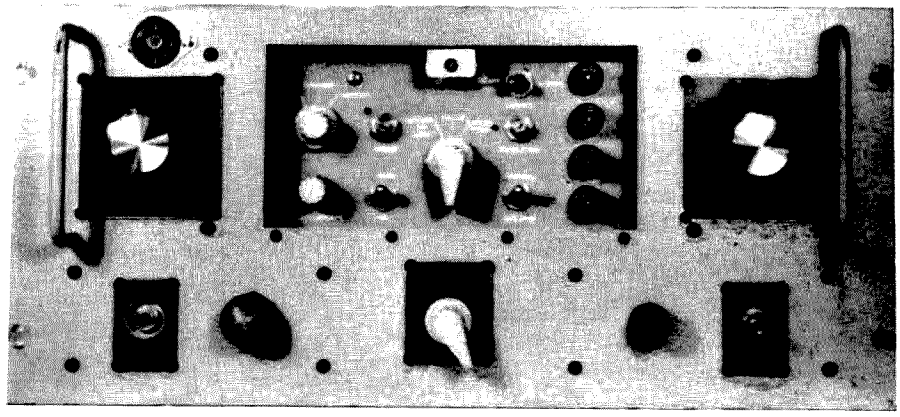
Model C4 Net $36.95

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The TT-63A as a Display Generator

James J. Wenskus, Jr. K2BEH
329 Ballad Ave.
Rochester, NY 14626

Teletype Repeater TT-63A/FGC is an inexpensive and widely available piece of surplus equipment. Although many amateurs have purchased this unit, problems in getting it into operation have resulted in most TT-63As gathering dust on a shelf or filling up useless space in relay racks. (It has a neat appearance and is fine for impressing neighbors or non-RTTY'ers.)

This article describes a novel use for the TT-63A as a Teletype character-synchronized sweep generator. The TT-63A recognizes a Teletype character as part of its basic function. This characteristic is used to generate a scope presentation in which the Teletype character is always perfectly synchronized, and time marks provided, at either keyboard or machine speeds. The basic concept is applicable to any other surplus Teletype equipment having this recognition capability. The "Selcal" could probably be used in a similar manner.

These modifications will cost less than $5, depending on the state of your junkbox, and shouldn't take more than a couple evenings to build.

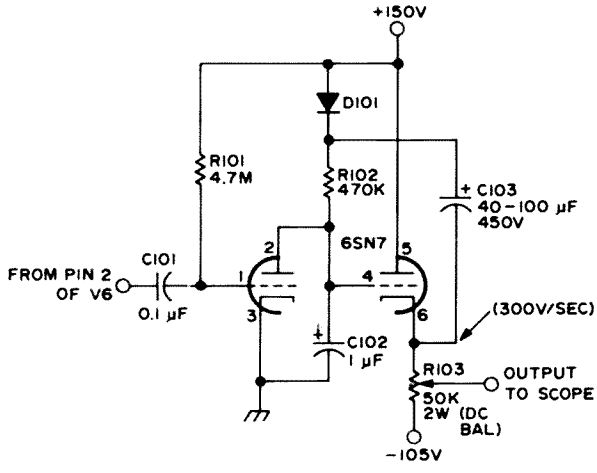


Fig. 1. The bootstrap sweep generator.

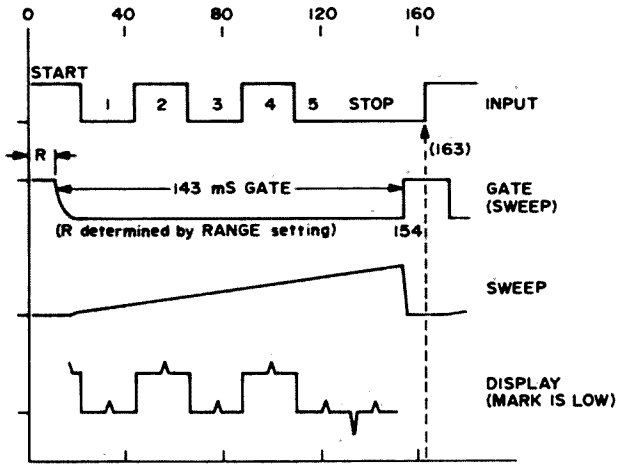


Fig. 2. Y waveforms and time relationships.

A few comments are in order. Attempting to convert this unit to a TU by adding a standard limiter-discriminator front end will not be particularly successful. This is due to two design peculiarities: The TT-63A is extremely susceptible to errors resulting from pulse splitting and the 1 ms sampling pulses coming in this hole. It needs a very good low-pass filter between the discriminator output and the trigger input. By the time you have added a truly effective low-pass filter, you will have probably duplicated half a TT/L without its benefits. Also, the chassis is too crowded for the required extra components. Another unfortunate characteristic is its performance at machine speeds when a "start" pulse is lost; the TT-63A prints several erroneous characters before timing synchronization can be regained. In adddition, if you are not using coax to your receiver, you may possibly pick up hash from the keying relay.

None of these problems will significantly affect its performance as a synchronized character display generator. Adding the simple circuits shown in Figs. 1 and 4 and slightly modifying your TU as shown in Fig. 3 is all that is required to make the TT-63A a truly useful RTTY accessory.

The Bootstrap Circuit Operation

Normally the grid of the 6SN7 is biased positive so that the tube is fully conducting. This effectively removes the charge across C102. When the negative 50V gate from V6 cuts this tube off, C102 begins charging through D101 and R102. The cathode follower portion of the 6SN7 feeds back the output ramp to the high end of R102 to maintain a constant charging rate and provide a linear sawtooth. With the components shown, the output is approximately 45V. The value of C103 is not too critical since the charging of C102 occurs mostly in its linear region even without bootstrapping. Removing C103 affects the amplitude far more than the linearity. It is necessary, however, to use a good quality capacitor for C102 – *don't use an electrolytic!* R103 allows the output signal to be balanced around ground. Some slight loss of signal results from this arrangement but it is effective and allows the scope to be switched from a cross tuning pattern to this pulse analysis mode without making centering adjustments on the scope. It should be noted that the start pulse is drastically shortened on the actual display. This is due to the poor risetime of the leading edge of the gating pulse.

Construction

The bootstrap circuitry is placed where V1, V2 and V3 were originally located. These tubes were part of the original tone portion of the repeater and are not used. The original 6SN7 (V1) is used as the bootstrap tube. One of the 6H6s may be used in place of the semiconductor diode shown in the schematic. The remaining

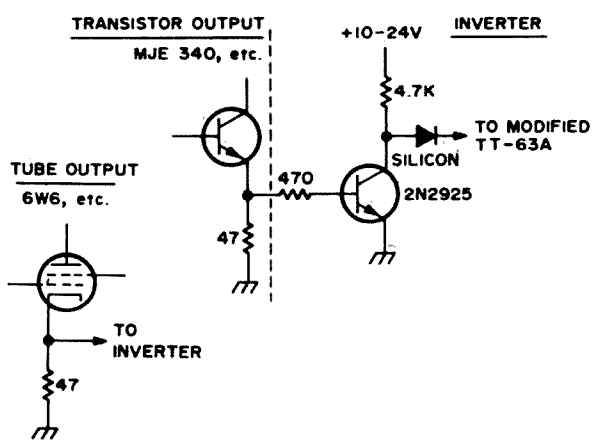


Fig. 3. Modifications of typical TU output stages to provide proper polarity pulses to the TT-63A input.

sockets are handy as tie points for the bootstrap components. Be careful when trimming wires on these sockets as several terminals are used for tie points for other stages. The sweep centering pot is a screwdriver adjustment type and can be located on the left side of the chassis after removing some unused tone parts.

The pickoff for the time-marked pulse display is shifted from its original point to the junction of resistors R55, R56 and R57. This change increases the amplitude of the time markers over the original point. A slight negative dc bias is introduced on the display by making this change but the resulting improvement in marker visibility is worth this slight inconvenience. The resulting display has vigorous negative pips where the pulse transitions should occur and lower amplitude positive sampling pulses. The range control centers the received pulses between these negative markers.

Connecting the TU

For proper operation of the repeater, the input to the Schmitt trigger must go negative on the stop mark. A few additional parts can take care of this requirement. Since most TUs can be readily modified to provide positive mark outputs; a simple inverter, shown in Fig. 3., is added to provide positive space pulses. The new repeater input circuit in Fig. 4 shifts the resulting 0V mark output from the inverter to a negative mark. My measurements show the Schmitt trigger turns on at −2.75V and off at −2V. To get the unit in operation, rotate R6 to the position which gives the best blinking of the neon. This setting is not critical.

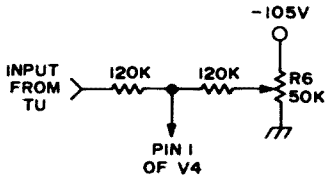


Fig. 4. TT-63A input modification to provide negative mark voltage for proper operation of V4. R6 is the input attenuator already in the unit.

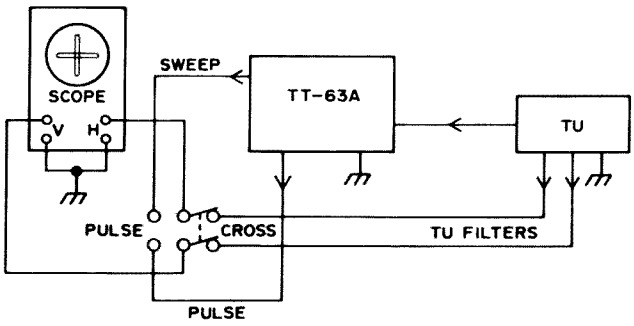


Fig. 5. Block diagram of typical component interconnections. The TT-63A subpanel can be rewired to do the required switching. Attenuators can be added to balance the voltages across the filters to that of the sweep and pulse voltages so that the scope gain does not need to be adjusted when switching displays.

Usage

When this system is set up, you can readily observe distortions on incoming signals, dirty contacts, the poor efficiency of your low-pass filters, etc. If your keyboard is in series with your selector magnets, you can readily check your own contacts. When I first tried this on my transistor TU, which had only 24V available to drive the selector magnet, the observed pulse distortion was appalling. Going to a high-voltage loop made the pulses look as they should. The vertical input to the scope can be connected to various areas of your TU and the pulses chased through always in perfect sync. This is a truly enlightening experience.

I use a 5 in. scope for my monitoring. Anything less will make observing the pulses too difficult. A dc scope must be used in order to pass these relatively slow waveforms without distortion. I find that the pulses are best viewed if the scope gain is not set too high. They are easiest to watch when they are almost square on the screen.

A very nice feature of this system is that you can tell if you have a legitimate RTTY signal tuned in and whether it is right side up, the right speed, etc., without turning on your printer. You merely see if a synchronized sweep is being generated by the TT-63A. This is possible only with a legitimate signal. This certainly saves a lot of useless clatter, bells ringing, waste paper, etc. when tuning across the bands.

...K2BEH■

John G. Oehlenschlager KØMOC
394D Ricketts Road
Monterey CA 93940

TELEVISION MONITOR

After building a Flying Spot TV camera, I acquired an old TV for a monitor. It was a typical early 1950 vintage set with a 10 in. screen and a 50 in. cabinet which a local TV repairman was happy to part with for $5. (Good thing I didn't have to pay for it by the pound!) It took only half an hour to modify the set for use with the camera. I was lucky, as it required no phase inverter or extra video amplification. But it was by no means the perfect monitor – modification required the addition of a SPDT switch, coaxial connector, a 75Ω resistor, and a short section of coaxial cable.

After using the converted monitor for several months, I began to modify the set even further. The controls were in the wrong spot . . . why leave the tuner connected, it just uses more power . . . get rid of that i-f strip. Finally, the only thing that remained was the power supply, the sync and sweep section and the video amplifier section. Even the original CRT went to the junkman. In its place I used an 8XP4 universal substitute tube. At this point no one could recognize the original TV configuration. I had even considered rack mounting the residue, but gave that idea up in favor of building a new

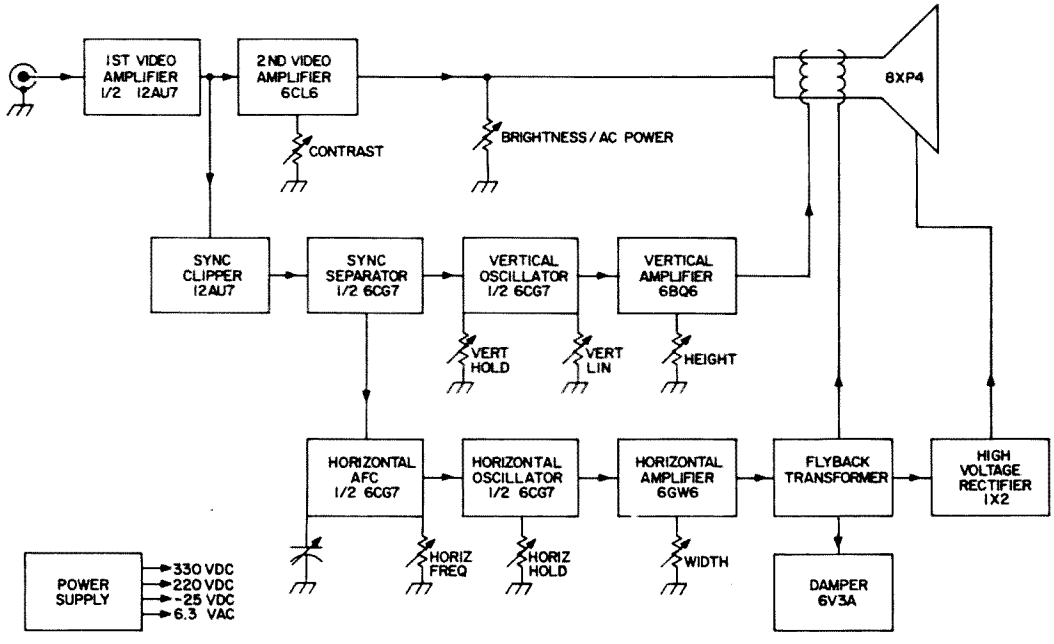


Fig. 1. Block diagram of the TV monitor.

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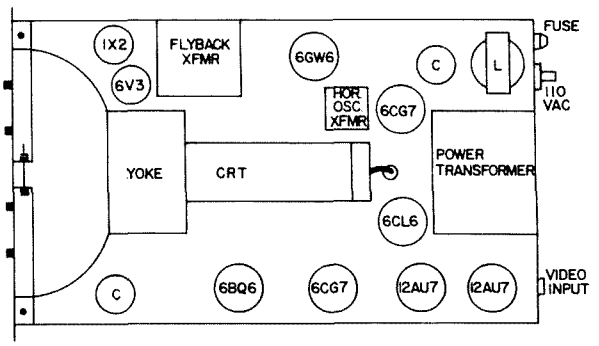


Fig. 2. The physical layout of the monitor.

monitor. Several points came to mind while designing the monitor. First of all I would limit construction cost to a maximum of $50. It must not employ any parts unavailable to the average ham. The operational controls must be located on the front panel for convenience. The monitor must be simple to adjust, using a minimum of test equipment. Finally, it must lend itself to modification to suit the individual builder.

Using these criteria, I was able to construct a monitor for $22 (less CRT). I was lucky enough to have a CRT left over from a previous project. A new 8XP4 will cost $22 to $28. The principal item I had to purchase was the cabinet. I used a Premier CC-2000 with a 3x10x27 in. aluminum chassis. The majority of parts came from several salvaged TVs obtained for the asking from a TV shop. Although I would have had no difficulty obtaining a horizontal output (flyback) transformer from a junked set, I chose to purchase a new one for $1. If you choose to use a CRT such as a 5AXP4 or 5FP4 (requires focus magnet) you may want to use a 70° yoke and transformer, also costing $1. 110° deflection components are also

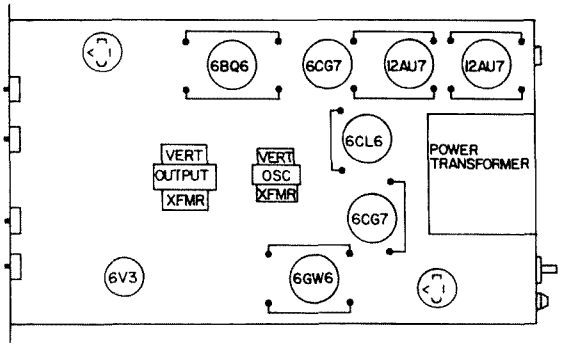
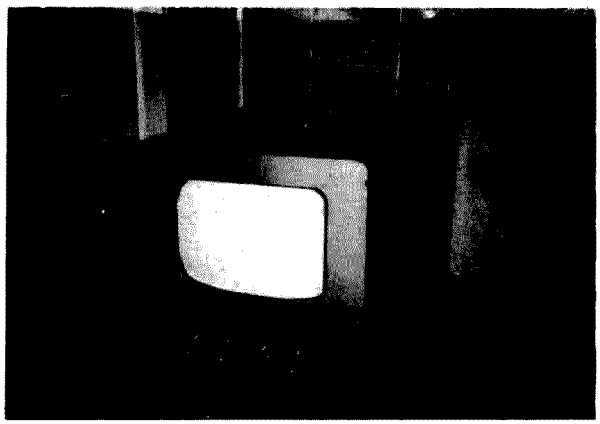
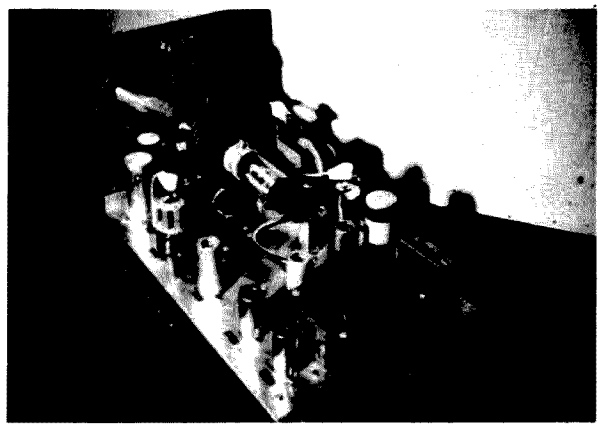


Fig. 3. To facilitate wiring, terminal strips are mounted in parallel rows.



Monitor exterior. . .



. . .and interior

available commercially. All other parts came from my junkbox.

The operation of the monitor can best be described by referring to the block diagram (Fig. 1). The input may be from ½ to 10V negative video from any 75Ω source. The output of the first video amplifier is fed to the second video amplifier and to the sync clipper. The output of the second video amplifier is applied to the control grid of the CRT.

The sync clipper consists of a normal voltage amplifier followed by a saturated amplifier. The output of the saturated amplifier contains only sync information (i.e. pulses of 60 Hz and 15.75 kHz). From the saturated amplifier the sync pulses are coupled to the sync separator. The output of the sync separator is sent to an integrator (low-pass) circuit (vertical sync) and a differentiator (high-pass) circuit (horizontal sync).

The differentiator output is coupled to the horizontal afc (control) tube. The horizontal afc keeps the horizontal oscillator (blocking oscillator) locked on frequency. The output of the horizontal oscillator is modified by the 330 pF capacitor to a sawtooth waveform at the grid of the horizontal amplifier tube. The output of the horizontal amplifier is coupled to the horizontal section of the deflection yoke by the horizontal output transformer.

High voltage pulses developed by the flyback transformer are rectified by the HV rectifier to provide 12.5 kV for the CRT. The damper suppresses oscillations in the horizontal deflection coil and provides an increased voltage (B+ boost) for the horizontal amplifier and the vertical oscillator.

The power supply provides 330V dc at 100 mA, 220V dc at 100 mA, −25V dc for fixed bias and 6.3V ac for all filaments.

The power supply was the most difficult part of the construction project. Three different circuits were tried before an acceptable supply was achieved. The supply uses silicon rectifiers throughout. Normally

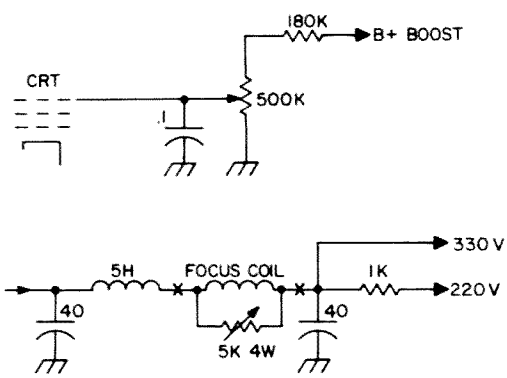


Fig. 4a and b. Two methods of supplying focus voltage/current to the CRT.

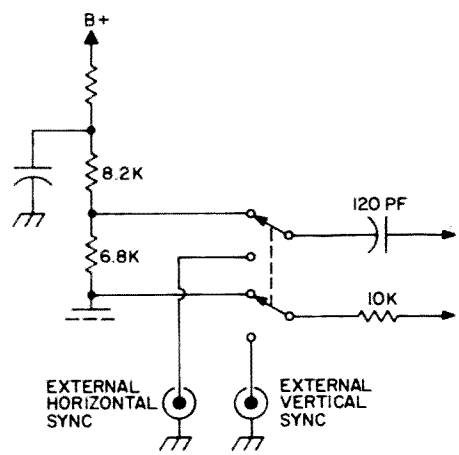


Fig. 5. A suggested modification for sync only input.

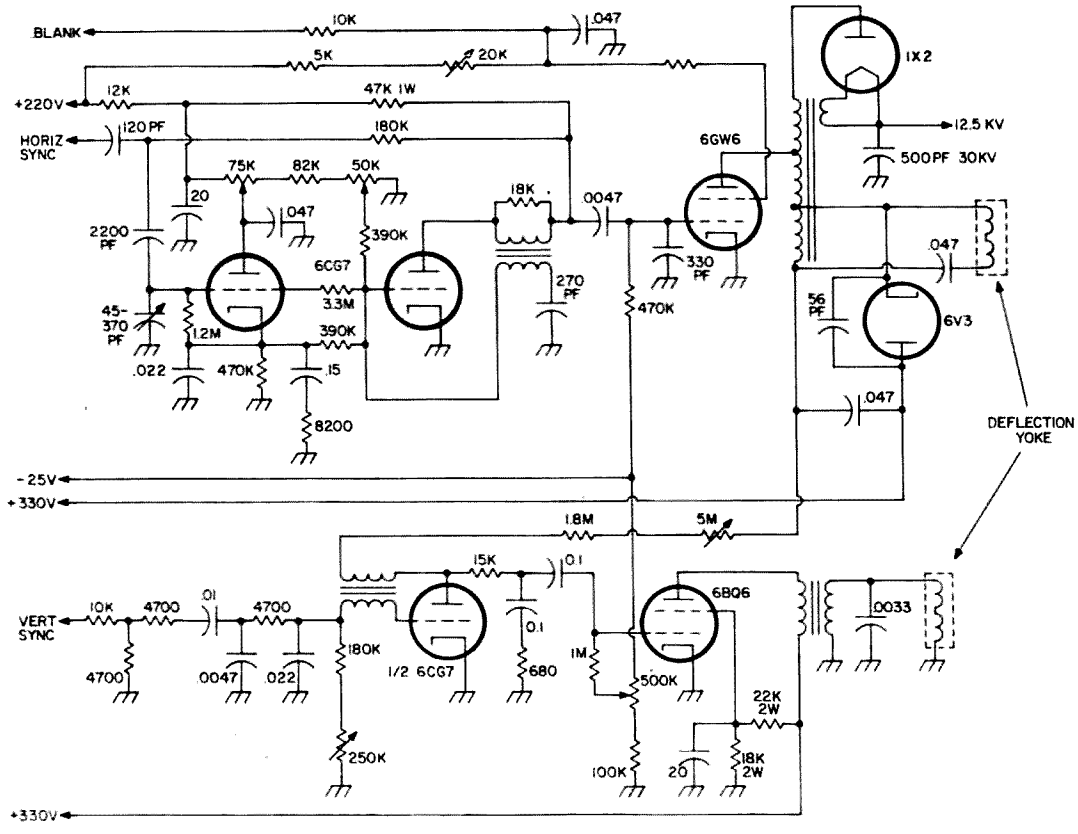


Fig. 6. Schematic of the deflection and high voltage section.

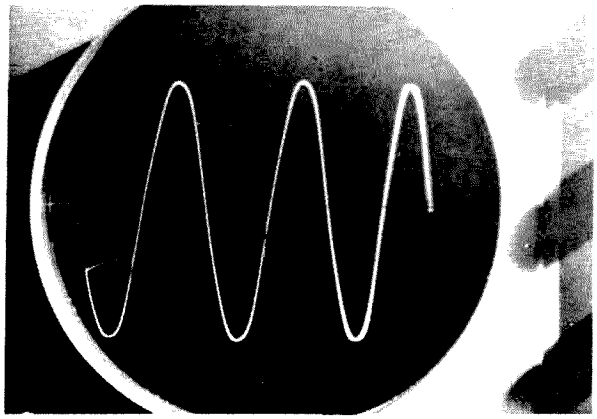
the power transformers from TV sets have three filament windings, two 6V and one 5V. They were used to obtain the negative bias voltage using a simple half-wave rectifier. If your transformer has only two 6V or one 6V and 5V windings, a voltage doubler should be used to provide the necessary −25V bias. The electrolytic capacitors used in the power supply section may have a greater capacity than those shown, depending upon what you have available; however, do not use less.

Mounting of the CRT may present some problems. I modified a mounting from a 17 in. set for my use. To simplify mechanical work, I obtained a yoke which clamped to the neck of the CRT. It required no other mechanical support, and there were centering magnets included on the assembly.

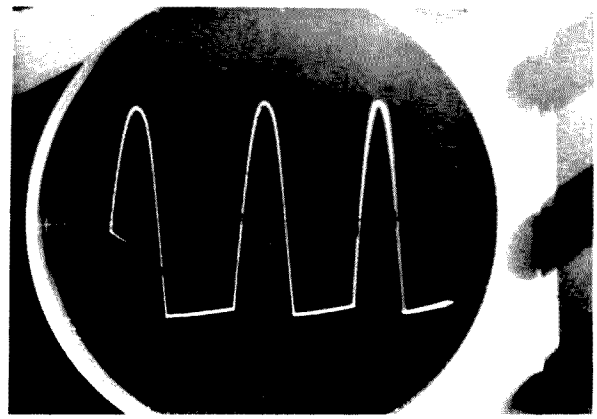
The layout shown in Fig. 2 was used. I encountered no problems with stray magnetic fields. The vertical output transformer and the vertical blocking oscillator transformers were located under the chassis. I used two four-section electrolytic capacitors, along with a couple of lead type electrolytics. There is sufficient room for another multisection twistlock electrolytic if you desire. To simplify wiring, 10 seven-terminal (2 ground) terminal strips were mounted in parallel rows as shown in Fig. 3. Other smaller terminal strips may be added as desired.

After wiring is completed, check carefully for errors before operating the monitor. For the smoke test, I recommend removing the horizontal output tube (6GW6) and the vertical output tube (6BQ6) and temporarily connecting the hot end of the height control to the 330V buss instead of the B+ boost. In my original model, I had the height control going to the 330V buss, but I was unable to adjust the height and vertical linearity satisfactorily. During normal operation the B+ boost voltage is 700V. This gives a very linear vertical sweep.

The test equipment needed for checkout are a VTVM with high voltage probe, an oscilloscope with a low capacity probe, and a source of ½ to 10V negative composite video. While a scope is not absolutely necessary, it is very helpful.



Vertical oscillator grid voltage waveform.



Vertical output plate voltage waveform.

Alignment Procedure

1. Turn on the monitor and allow it to warm up for 5 minutes. Keep a sharp eye out for overheating of resistors or tubes.
2. Set all controls at mid-rotation.
3. Connect the source of video to the monitor.
4. Check each video stage for signal. You should be able to trace it right up to the CRT control grid.
5. Check vertical oscillator for correct operation.
6. Insure that −25V is available for the vertical and horizontal amplifier grids before proceeding. Then insert the vertical output tube. Be sure that the deflection yoke is connected. If it isn't connected the tube and the transformer may be damaged. Using low capacity probe, check the waveform across the vertical deflection yoke. Rotate the vertical hold, vertical linearity, and height controls and observe their effects on the waveform. Using the VTVM, set the vertical amplifier control grid voltage to 15V using the vertical linearity control.
7. Check the horizontal oscillator using the low capacity probe for proper operation. By adjusting the horizontal frequency, horizontal hold and horizontal stability there should be a 15.75 kHz, 60–90V peak-to-peak sawtooth waveform. When you are satisfied that the oscillator is functioning correctly, turn off the monitor, insert the

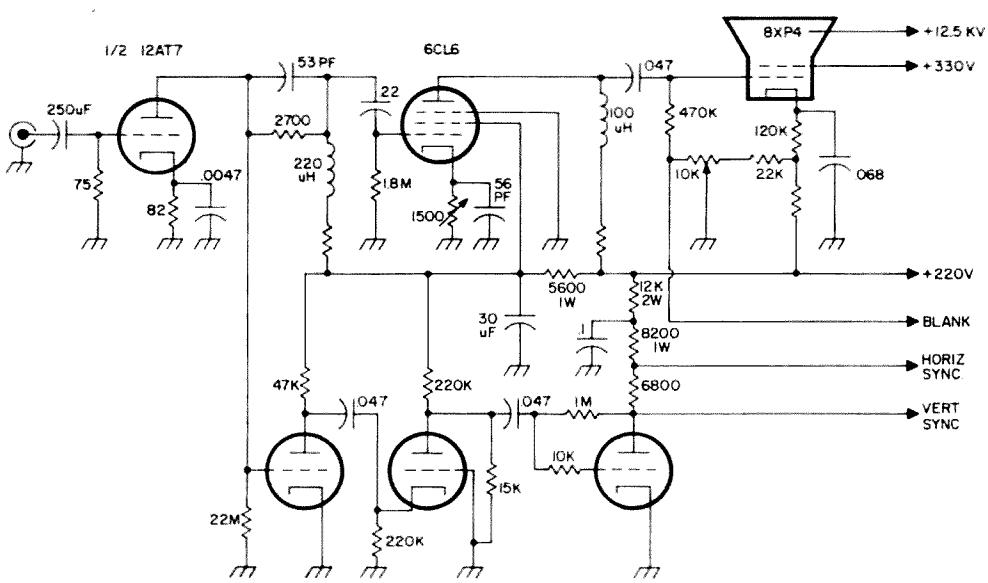
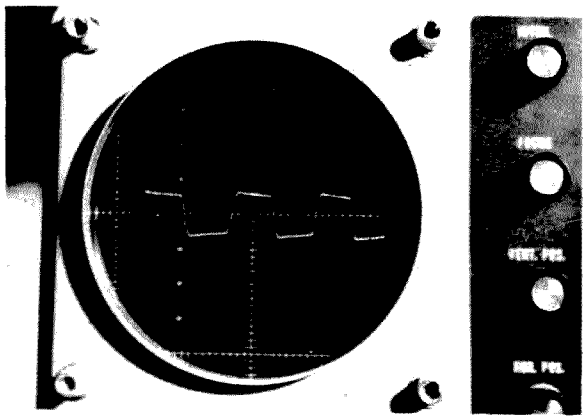
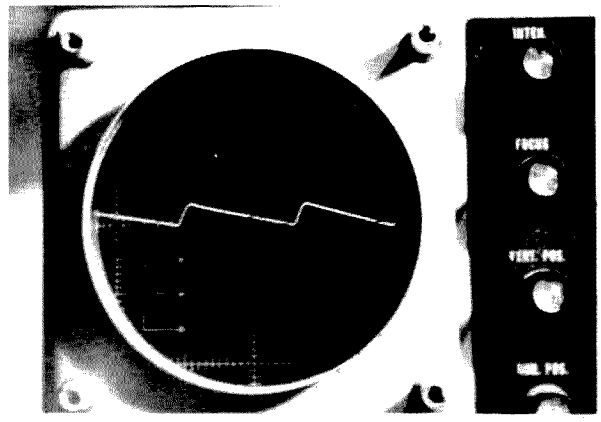


Fig. 7. The video amplifiers and sync separator/clipper.



1000 Hz video test square wave at CRT grid.



Horizontal deflection coil current waveform.

6GW6 and reconnect the height control to the B+ boost.

8. Re-energize the monitor, again looking for overheating of resistors and tubes. Adjust the brightness control to about mid-rotation. The CRT should light and a raster should appear. With the VTVM (using the HV probe) check for B+ boost (500 to 700V) and HV (10 to 15 kV). Adjust the width control for 100V on screen of 6GW6. Adjust the height control for a 100V peak-to-peak 60 Hz sawtooth on the vertical amplifier control grid.
9. By adjusting the front panel controls, you should be able to obtain a picture. Adjustment of the yoke (mine had centering magnets attached) may be necessary. If the picture is upside down or mirror image, reverse the necessary yoke leads.
10. Fine adjustment may be accomplished by using standard TV alignment procedures. Notice that the horizontal hold and horizontal frequency controls interact, as do the width and brightness.

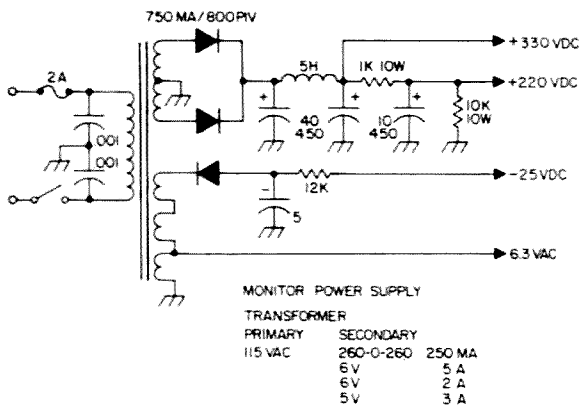


Fig. 8. Monitor power supply.

I get carried away using silicon diodes. Originally I used a 3000 PIV 200 mA diode for the damper. After two frustrating failures, I used a 6V3A. If any of you more persistent types desire to try a silicon diode, use at least a 5 kV PIV 200 mA diode. If you use a 6V3A remember that it has a cathode cap and not a plate cap. It won't work the other way!

As for substitution of tubes, a 6BQ6 could be used in place of the 6GW6. However, with the high B+ boost voltage present (700V) I used a 6GW6.

I used an 8XP4 universal test tube, although any one of several CRTs may be used. An 8YP4 may be used if 110° deflection components are used. An 8KP4 may be used if correct focus voltage is supplied to the focus anode. An 8DP4 may be used also; however, it requires – in addition to a focus voltage – a single field ion trap. A 5 in. tube such as a 5AXP4, 5AHP4 or a surplus 5FP4 could also be used. The 5AXF4 requires no external focus supply. The 5AHP4 requires a focus supply of 0 to 250V. The 5FP4 is an electromagnetic focus tube. Figures 4a and 4b show methods of supplying focus voltage/current for other CRTs.

This monitor was designed as a basic building block for future projects. For those with a master sync generator, a *sync only* input may be desirable. A suggested modification is shown in Fig. 5. Other changes/adaptations may be made to the basic design to fill the requirements of the builder.

. . .KØMOC/4



73 Tests

THE ICOM IC-21 TRANSCEIVER

The word has leaked out around the U.S. about the Japanese IC-20 and IC-21 transceivers, fueled by a handful of units brought back by visitors to Japan and returning servicemen. Now, at last, these goodies are being made available through a U.S. importer.

Adirondack Radio was kind enough to lend their first sample for a test and it certainly was impressive. The most spectacular aspect of the rig is the 24-channel frequency switch, complete with an easy-to-get-at board for the 24 crystals and tweaking capacitors immediately at hand.

Now, while you may live in an area which only has one or two repeaters, those of us in the northeast are living in an entirely different world, one jammed with repeaters on just about every pair of channels. Though the 73 HQ is in a remote corner of lower New Hampshire, there are now about 17 repeaters that can be used with a simple antenna. Three miles away, from the top of Pack Monadnock mountain, where we test out new equipment, there are a whole bunch more within easy reach. A 24-channel transceiver looks awfully good for a spot like this.

The IC-21 has so many nice features that it is difficult to decide which is the most desirable. It has an ac supply built in and will operate from either 115V ac or 13.6V dc, making it a dandy unit for both base and mobile applications . . . and particularly valuable to the operator who wants to be able to use one rig both in the car and at home.

The transmitter puts out 10 watts on the high power position of the output switch and one watt on the low position, making it possible to save on battery power when operating through most repeaters.

Experienced FM operators will appreciate the variety of meters on the IC-21. Just above the channel switch is a deviation meter which indicates how much off frequency the incoming signal is. This meter is calibrated plus and minus 5 kHz. There is a control on the front panel to compensate for this off-channel stuff . . . a Receiver Incremental Tuning control which swings the receiver back and forth about 5 kHz. Since not all 94 repeaters are on 94 and not all 76 repeaters are exactly on 76, this is a handy control to have when you are moving from one area to another.

The S-meter on the receiver comes in handy when you want to identify which of several repeaters you are hearing and there is no identification at the moment. At our mountain lab site we hear W1ALE in Concord on 94 at umpteen over 9, WA1MHN in Somerville, Mass., at S-9, WA1KGR in Holyoke, Mass., at S-8, and W1KOO on Mt. Mansfield, Vt., at S-1, so you can tell from the S-meter reading exactly which repeater is being heard at any time. On 88 the S-meter permits instant identification between W1ABI, WA1KFX, K1AOI, W1ZAW, WA1JTB, and WA1KHK.

The S-meter becomes a plate tuning meter on transmit or an SWR-meter, with a flick of the front panel switch. There is a

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plate tuning control on the panel, permitting the plate to be peaked on any channel, thus overcoming the serious drop in power you suffer with some rigs when you change frequency from one end of the band to the other.

The mike gain control on the front panel is useful for setting your deviation to match the repeater you are using. Some are wideband, some narrow, and some compromises. With a little fiddling around you can find out what works best with each repeater and use that deviation from then on.

Some of the statistics, briefly: weight 14 lbs; size 4½" high, 9" x 10", will obviously fit under most dashboards; draws 0.2 A on receive, 2.1 A on high power, and 1.2 A on low power; uses 18 MHz crystals for the transmitter and 15 MHz for the receiver; i-f is the usual 10.7 and 455 kHz.

An automatic protection circuit disables the driver transistor if anything happens to the antenna, thus keeping the final transistor from going west when the antenna is shorted or opens up.

A low-pass filter on the output is designed to keep interference down to neighboring television sets.

The IC-21 is designed to be mounted by means of a bracket in the car and a built-in folding foot stand angles it for use on the operating table.

An external vfo may be used with the IC-21. It plugs into one side of the cabinet. There is a jack in the back for an external speaker, which is very handy for car installations where you would prefer to listen to the regular car radio speaker than the smaller one on the transceiver.

Since the transmitter and receiver units are independent of each other, a good technician might be able to convert this rig rather easily into a repeater. It wouldn't take a whole lot of work. The modular construction of this rig would make such a "conversion" much easier than with most transceivers. The fact is that you can get at almost everything on the IC-21.

The IC-21 is being imported by Adirondack Radio, Amsterdam, New York and sells for $389.00.

. . .K1NUN

73 Tests The REGENCY Transcan FM Transceiver

A scanning transceiver was the obvious next step in two meter FM transceivers. There are so many repeaters in action today, even in the more remote parts of the country, that the FMer needs some way of keeping track of which are being used. Back in the old days, a year ago, when there was only one repeater in most areas, a simple monitor receiver was all that was needed to keep in contact.

As 1972 unfolds we find that most major urban areas have four to six repeater channels perking and, unless the FMer has his hand on the channel switch a whole lot, he misses out on most of what is happening. It gets to be quite a drag to reach up and switch through all the channels every few minutes. It is a lot better to have a couple of ICs and some transistors doing that for you, automatically.

Regency has married their scanning VHF receiver and their very popular HR-2 two meter FM transceiver and come up with a package which does everything for you except keep the log. The receiver scans eight crystal controlled channels and, when any one becomes active the light turns on, the scanning stops and the squelch turns off so you can hear the station. Each of the eight receive channels may be locked out of the scanning function by pushing a button over the channel lamp. This is handy when one channel is active and you want to scan all but that one . . . or two, etc.

There are six crystal transmit channels which are selected by the buttons under the receive channel lamps, which leaves two receive channels which can share any of the six transmit channels with another receive channel. Pushing the transmit button locks the receiver to that channel until you push the "scan" button which disconnects all transmit crystals and sets the receiver to scanning again.

This setup is ideal in the areas I frequent, fitting the six repeaters we use in New Hampshire and southern Vermont. When I head down Boston way I change the crystals for the six active repeaters down there (W1QFD, WA1KGS, WA1MHN, WA1NJR, W1HWK, and WA1KGO). If I'm driving to New York, which happens often, I load up for WA1KGQ, WA1KGR, WA1KGD, WA1KGK, WA1KHK, and WA2SUR. And so it goes, with my being able to talk through a selection of repeaters no matter where I am.

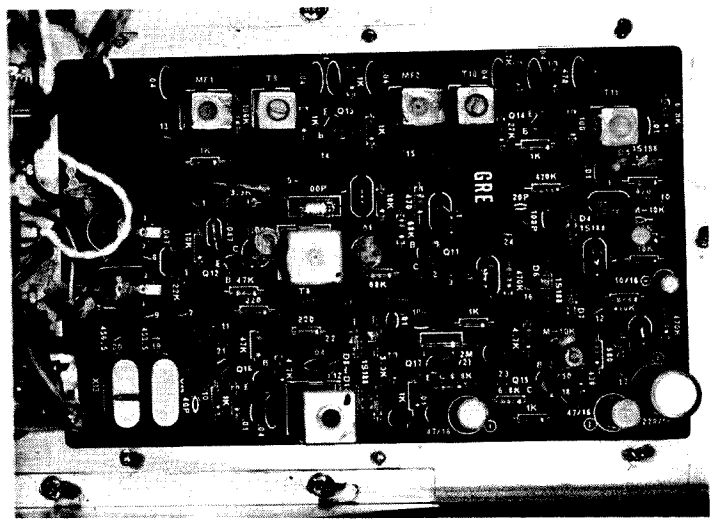
The Transcan is extremely handy at 73 HQ where I monitor not only the six fairly local repeaters, but also listen for calls on 76 and 94 simplex from passing FMers. We have a pot of coffee at the ready for visiting amateurs and do appreciate the company. The Transcan has also alerted me to several band openings which have permitted me to talk down into New York and even points further away.

The scanning function is accomplished by a couple of ICs which switch the receive channels by means of diodes and sample the channels, stopping when the squelch is operated by a carrier. There is automatic protection of that expensive output transistor too, with a little circuit that senses if the antenna opens or is shorted and turns off the drive to the final.

All in all, Regency has come up with one of the best fun-makers for two meter FM yet. I don't have time to switch through all the channels while I'm driving to see who might be coming through. The Transcan does it for me and even the shortest blip of a carrier stops everything and lights up the active channel. The price is $319 for the mobile model and $349 for the desk model with built-in 117V ac power supply.

. . .W2NSD/1

73 Reviews The Allied AX-190 Ham Receiver



If all receivers performed as well as they looked, a ham would have no trouble in obtaining a good one. The trick is finding the good receiver that is behind the pretty panel. The Allied AX-190 is such a one. Behind the brushed aluminum front are five printed circuit boards that hold all components in very neat arrangements. On one of them is the four FET front end which is rated at 0.5 μV sensitivity at 10 dB S/N. Our test unit performed very well with no more than a longwire, and we have no reason to doubt the accuracy of the manufacturer's statement. This receiver picked up many weak stations that other radios could not hear. The preselector is very sharp and sensitive and really peaks up signals while rejecting interference from strong off-frequency stations. The receiver covers eighty through all of ten meters in 500 kHz bands. There is also provision for adding another segment of the 3.5 – 10 MHz range.

For those strong signals that cause QRM, the Q-Multiplier does an excellent job of eliminating heterodynes and peaking the desired signal. This feature is certainly a desirable one for CW and SSB ops. Signals here were raised by thirty to forty decibels, and when the rejection mode was selected, annoying whistles were eliminated.

CW and SSB are received well by means of a four diode balanced modulator circuit. The first oscillator and bfo are crystal controlled for sharp and accurate tuning. The audio is clean and pure, and almost hi-fi – in short, very comfortable. Dual conversion and ceramic filter add measurably to easy listening.

For those who might want to listen to AM stations that are outside the ham bands, an AM position and AM with ANL are provided on the function switch. Incidentally, the diode noise limiter performs very well to take out ignition and electrical noises (i.e., the fluorescent light on my desk).

As for minor features that add to the pleasure of owning the AX-190, there is a 25 and 100 kHz calibrator for accuracy of the smooth tuning vfo knob which has one kilohertz markings on the resettable skirt. The rig also has provision for operation directly off of 12V dc, making the rig valuable for mobile, Field Day, emergency, and portable use. Antenna input is a common SO-239 chassis connector, provision for muting, and vfo output round out the features of this receiver. One other valuable feature of the rig is the accompanying instruction manual. It is complete with an excellent theory of operation section that includes excerpts of the complete schematic showing the various stages in their individual and combined design states.

For the ham who is looking for a good receiver, portable, or emergency receiver, at $249.95 this receiver needs careful consideration. Novices in particular should keep in mind that a few extra dollars on the receiver purchase can add proportionally greater enjoyment to his operating experiences. And when upgrading his license, this receiver will keep its value in the station.

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PHONE PHREAKS VS Ma BELL

"Little Box Blue, get on the horn" is the call of a new band of public nuisances, the self-styled "Phone Phreaks" who have been using a small electronic device, known as a "Blue Box," to defraud the telephone services of an estimated half million dollars a year.

73 talked with Dennis Mollura at the Bell headquarters in New York about these Blue Box activities.

First, Mr. Mollura described Blue Box operation:

"They are used to call the network signalling function on the telephone network. If you build a Blue Box that has the proper tones and you know how to use it you could tap out the right tones to give the network its command; then you'd be able to avoid our automatic billing equipment."

These tones are the twelve dual-tone combinations of six frequencies used only for network calling frequencies, and are not the same as a standard Touchtone® phone would produce. You may have noticed, after dialing a long distance call, a rapid succession of higher-than-Touchtone® frequency tone-pairs lasting about a second. These are the network control tones.

A Blue Box user first seizes a long distance line by phoning a toll-free long distance number, most often a directory assistance or IN-WATS (area code 800) number, then hanging up on the callee while retaining the circuit by generating his own 2600 Hertz "disconnect" tone. The 2600 Hertz tone would normally not appear on line until the caller has hung up, and once sensed, is regarded by switching equipment as a signal to disconnect. The captured line is then used to call anywhere in the world at the caller's whim. Most "Phone Phreaks" figure they're getting away with it, but the feeling is usually ephemeral.

"There are three ways which we use to try to detect Blue Box fraud; number one would be plant service center testing (with very common electrical testing equipment) . . . another way is traffic pattern analyses . . . then the third way is computer programming. The computers are watching the networks and they . . . can spot trouble . . . and kick out a trouble report card."

It would appear that most of the current users of Blue Boxes are now at this point in telephone company investigations. They have some unpleasant surprises in store for them if they should be so naive as to think that this is as far as the investigations go.

"When we suspect a case we can put on sophisticated electronic gear . . . which can help us track down the people.

"We've . . . begun a nationwide crackdown. In 1970 there were six people arrested, two convicted, four cases pending. So far this year (September), thirty-three arrests, eighteen convictions, fourteen pending, one dismissed. In the Montana area, a group of ten people . . . were using Blue Boxes. We (actually, the FBI) moved in on them . . . they were indicted . . . and arraigned, and the evidence was so overwhelming that seven of the ten pleaded guilty right off the bat, two of the cases are pending, and one is dismissed."

Naturally, the Blue Box users aren't hurting anybody, unless you feel that having to pay their way yourself is an imposition.

"People are trespassing on the telephone network. They're literally stealing service, and actually increasing the cost of telephone service for people who do pay. I can describe this as like a guy getting on a turnpike and not stopping at a toll booth. He's creating a demand for service, but he's not contributing his share. "Our losses due to Blue Box fraud . . . we're estimating at about five hundred thousand a year."

With a half million dollars a year at stake, why not just clamp right down?

"One of the reasons that we gather evidence for so long, like in the Montana case, is to establish what the person's calling pattern is, to try to determine when he got the box, how often he used it, and where he called. Once we establish a pattern and can pinpoint when he got the box, then we go for full restitution. In cases we've been able to get it."

So far, no amateur radio operators have been involved, but the people who were involved might well have become hams.

"Of the thirty-three people arrested this year, twenty of them were students, one was a private detective, one was a communications man, and most of the rest had electronics background interest."

What is the phone company position on the use of these devices?

"We consider this a very serious matter. People are trespassing on the telephone network. We do have means of detection, and we are confident that we are eventually going to catch them all. When we get them, we are going to press to the fullest extent of the law, and we're going after full restitution of the money we've lost so far."

Amateurs who have been using 2600 Hertz notch filters and 3400 Hertz roll-off low pass filters in conjunction with phone patching have most of the protection necessary to prevent accidental interference with telephone service.

'The Blue Box enables you to place calls without charge. There's another electronic device which would enable people calling you not to be charged. I'm sure you're very familiar with this. I have an article written by you in the September 73. There was some concern. Someone in the telephone company spotted the article and was somewhat concerned about it. I checked it through and it's a legitimate article. It has a disclaimer at the end . . .there's no problem."



Chester County (PA) Detective Ronald Johnson (right) displays an illegal "blue box" used to bypass toll charges and seize long distance telephone circuits. Johnson and Chief of County Detectives Eugene Sharpe (left) were part of a law enforcement team (September 27, 1970) which raided several Chester County residences of suspected "phone phreaks." The "phreaks" use homemade electronic generating devices such as the "blue box" to place free long distance calls all over the world, sometimes for hours at a stretch. Four persons were arrested in connection with charges ranging from toll fraud to impersonation of telephone company employees and, in one case, wiretapping. Authorities said "several carloads" of illegal equipment were confiscated, some of which is shown here.

Most of the details concerning the particulars of design of the equipment used by the phone company in tracking down the Blue Box Banditos must, of course, remain confidential for the moment. 73 will continue to monitor developments in the case of the Phone Phreaks versus Ma Bell, and will release pertinent new developments as they become available.

. . .WB8LBV

References:
ESQUIRE, October, 1971, p. 116 "Secrets of the Little Blue Box" by Don Rosenbaum.
73, September, 1971, p. 117, "A D.C. Isolator for Phone Lines" by Martin Weinstein.

AFSK REVISITED

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Many hams are lured into the wonderful world of Teletype by the promise of unattended autostart, automatic message handling, or the ability to send fancy holiday greetings. They often find, however, that such operation is practical only on VHF, where non-drifting, non-fading signals make such transmissions easy. Such a finding is not wholly true. Although sophisticated converters can work wonders on the lower frequencies, advanced circuitry is hardly the answer a newcomer to Teletype needs. Unfortunately, that is about all he has gotten – until now. Unlike earlier circuits, the audio frequency shift keying (AFSK) generator described here uses a bare minimum of parts. It gives a reasonably good sine wave output and – using the keying technique included – a minimum of transits or bias. The keying technique referred to is the application of a new device, the magnetic reed relay, to a Teletype keyer. The reed relay can be used not only to key this AFSK generator, but standard FSK units as well.

Simple circuits published previously have contained at least two transistors and a reasonable amount of other software. A look at the schematic, Fig. 1, shows this oscillator to have only one transistor and a minimum of other components. The actual audio shift is accomplished by switching an additional capacitance in parallel with the toroid to lower the tone on "mark." On "space," the switch is open and a higher tone (from less parallel capacitance) is generated. Although Cs and Cm are shown as one capacitor each, they are in reality several capacitors paralleled to give the desired resonant frequency. For such work, you cannot rely solely on the marked value of the capacitor. Tolerance variations can play havoc with combinations set up in that manner. Rather, true trial and error should be used to determine the values after the rest of the circuit is completed.

For newcomers, the use of Lissajous Figures is the most practical method of

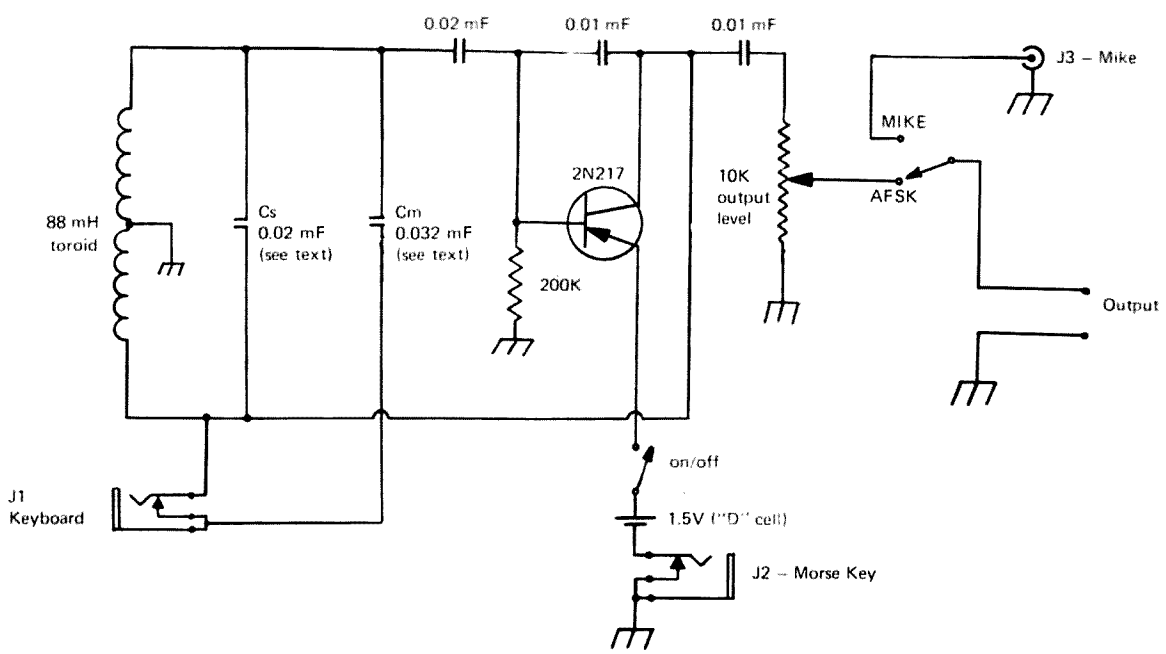
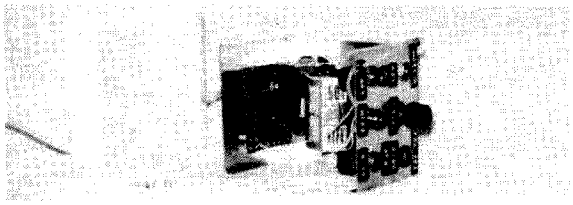


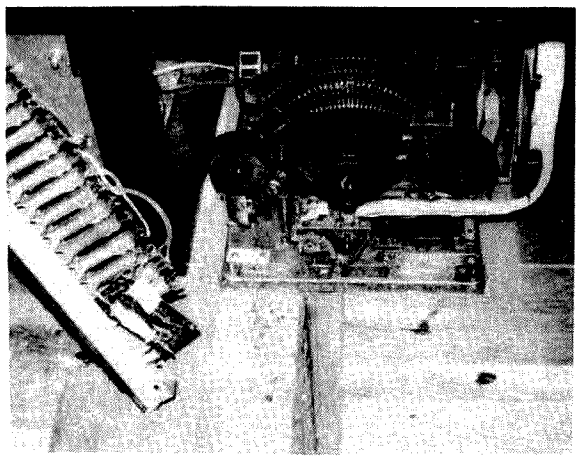
Fig. 1. Schematic of AFSK tone generator.



This is an overall view of the AFSK unit, showing front panel and interior circuitry.

audio frequency determination. Briefly, setting up the circuit shown in Fig. 2 will allow frequency matching to within a small percentage. The source of the standard frequency will be investigated later. For the time being, such a standard is merely a known-to-be-accurate signal source. While observing the scope face, try various small capacitors of the approximate suggested values (or use a capacitor decade box if one is available) until a circle or ellipse appears on the screen. When that happens, the two audio sources are within one hertz of each other.

Another method may be used for those lacking an oscilloscope. This technique, almost forgotten in amateur circles, is one using audio beats to match frequency. It permits matching to within one hertz, and gives a better result than Lissajous Figures for tones separated by several hertz. The audio beat method involves feeding the standard tone into a loudspeaker and the



This is the Teletype patch (jack) panel with the reed relay assembly shown on the right end of the strip. The relay is enclosed in the coil, which is wrapped in masking tape. The unit is then attached to the printed circuit board referred to in the text.

AFSK generator to be calibrated into another (both through amplifiers, of course). As the generator frequency is adjusted to that of the standard, using trial capacitors or a decade box – as above – audio beats, that is, variations in amplitude, will be heard. When the beat frequency is less than one or two per second, the two audio tones are matched within one hertz.

Since exact frequency tolerance is not needed – it makes little difference to the receiving operator whether your "mark" is 2125.0 Hz or 2126.7 Hz – the audio beat method is perhaps better suited to the newcomer with only a limited audio refer-

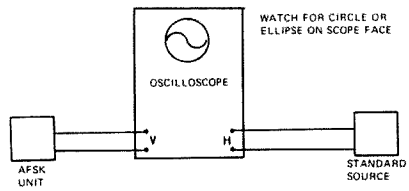


Fig. 2. Simple frequency matching setup.

ence source. At, say, five hertz separation between tones, the oscillographic Lissajous Figure will be a meaningless blur, while audio beats will be present at a rapid rate. Thus, adjusting the tones by the beat method, once slow beats are obtained, the frequency is within fair limits.

Although much has been said so far about the "standard" frequency, details have not yet been given. Such a standard should be capable of supplying the mark frequency, 2125 Hz, and the space frequency, 2975 Hz, at a reasonable level of accuracy, stability, and sine waveform. Perhaps the easiest standard to use is another AFSK generator, known to be accurate. Such a generator could be borrowed from a friend or its signal used over a strong VHF link. Alternatively, a calibrated audio generator could be set up for the 2125 Hz mark and 2975 Hz space tones. A third method is available to the ham who has an operating demodulator. Tune in a strong carrier on the receiver, as from the transmitter's spot function or the 100 kHz crystal calibrator, and adjust the bfo to give the proper tones for Teletype. To calibrate the generator, adjust the standard to produce the tone for space (2975 Hz). Adjust Cs until the AFSK unit produces the correct space frequency, as

measured by either of the frequency matching methods above. Close the switch grounding Cm and move the standard to the mark tone (2125 Hz). Adjust the value of Cm for the correct mark tone. Recheck the space tone to be sure interaction has not changed it. Feed the signal of the AFSK generator into the mike input of your transmitter, adjust the level control for 100% modulation, connect a key at J2 or a mike at J3 (for the CW or phone identification required), and you are on the air.

If you connect this directly to your keyboard contacts you may have some problems. First of all, the generator must be keyed "dry." That is, there can be no current or voltage on the keying line. Second, the contacts used to key must be clean. While not so much of a problem with a keyboard, the rotating contacts of few T-Ds are clean enough to key this circuit without hash. The solution to these problems is to key through a set of contacts separate from the Teletype loop.

For years, the only accomplished way to do this was by a polar relay. Other, spring-returned, mechanical relays differed too much in their make vs. break current to key without bias (changing the length of the 21 msec Teletype pulses). Recently, however, a new device – the magnetic reed relay – has come upon the scene. Literature has described this device as being able to operate upwards of 2000 Hz. If a 2000 Hz signal were fed to the activating coil, the contacts would make and break 4000 times a second. Each actuation would be 0.25 msec long. It appears, therefore, that the relay could operate on the 21 msec Teletype pulses. Such a relay was procured from a local supply house, and a coil wound on the form enclosed with the relay. The coil has several thousands turns of 32-gage wire, and a dc resistance of 45Ω. It readily pulls in on 40 mA, thus the 60 mA local loop current assures positive action.

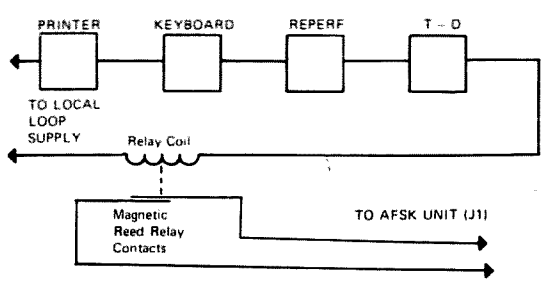


Fig. 3. AFSK keying arrangement installed in loop.

Transmitting tests using the relay to key the low frequency FSK rig showed no detectable bias. The relay was then installed into the loop as shown in Fig. 3. For mounting convenience it was fastened to a small printed circuit board, origin and original function unknown. The magnetic relay is now used for keying both the AFSK and FSK rigs, with excellent results.

Construction techniques are entirely up to the builder. At WA3AJR, the AFSK oscillator is built on a small piece of perf-board and mounted in a minibox with its complement of jacks and switches. The magnetic reed relay, as noted, is attached to a piece of printed circuit board for support, then mounted behind the Teletype patch panel.

The circuit shown here is, to me, a fast and easy way to transmit on VHF Teletype. It is not recommended that the output of this particular AFSK generator be fed to a sideband transmitter to attempt low frequency FSK. The output of this circuit, while a reasonably good sine wave, is not perfect, and some spurious sideband generation may result. The relay keying circuit is applicable to all phases of Teletype, and can be used in preference to a standard polar relay. If reversal of the tones or keying mode is desired – not necessary, but perhaps desirable in some cases – SPDT reed relays are available. The total elimination of a bias supply (needed with a polar relay) and the ability to separate receiver and transmitter from the same frequency and still maintain local copy are easily appreciated.

Several modifications to this circuit are readily apparent. One amateur who built it added an extra transistor as a switch to further isolate the keyboard, instead of the relay. Another built the unit on a printed circuit board. Each, however, has retained the simplicity of the tone generation circuit and discovered the fun in VHF Teletype

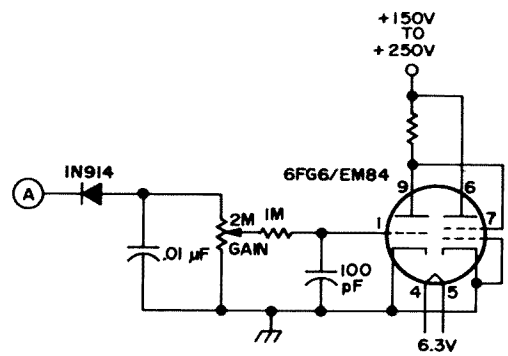
. . .WA3JR

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Tuning Indicators for SSTV Monitors

For several years I have been experimenting with SSTV and have realized that there is a need for a device to aid in tuning the SSTV signal to provide the correct audio output tones from an SSB receiver. I've developed and tested tuning indicators for SSTV monitors in both solid-state and tube-type designs. The type used with tube model monitors incorporates a 6FG6 light bar indicator, and a light emitting diode (LED) is used with solid-state designed monitors.

Solid-state and tube-type SSTV monitors equipped with tuning indicators are shown in the photograph of Fig. 1. The monitor on the left is a tube-type based on the design by MacDonald (QST, March 1964). The light-bar tuning indicator is located just below the CRT screen. The monitor on the right of the photograph is a solid-state, magnetically deflected design based on a circuit by Make Tallent W6MXV. The LED tuning indicator is installed just below the vertical reset push-button.



Tube-Type Tuning Indicator

The signal diode on the indicator input (point A of the schematic diagram) should

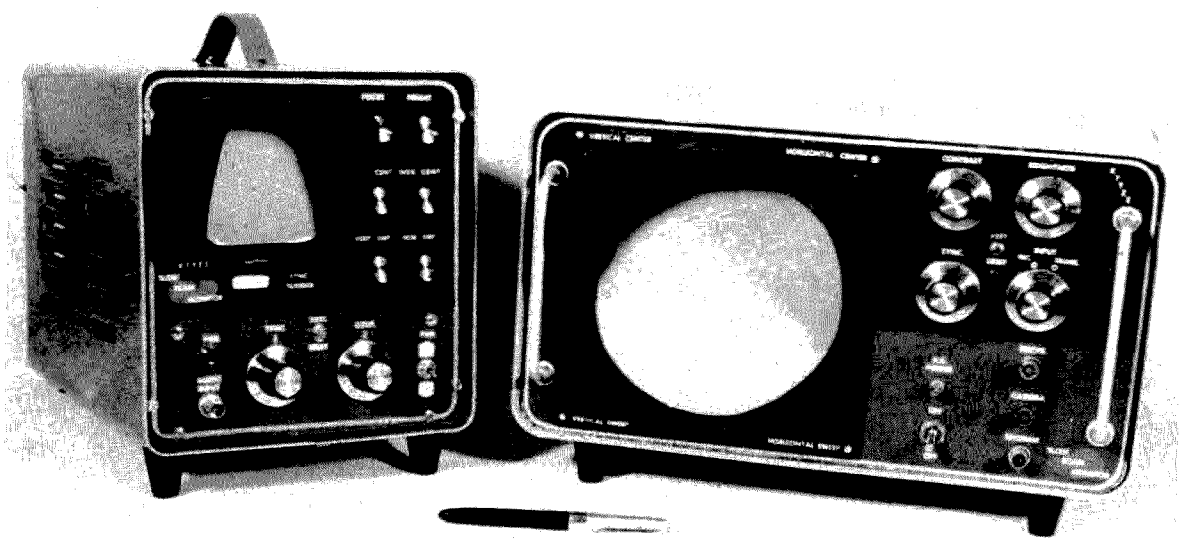


Fig. 1. Tuning indicators for SSTV monitors.

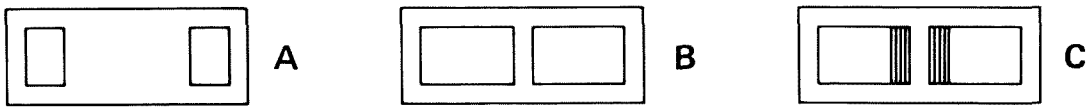


Fig. 2. Tuning indicator displays. The no-signal state is shown in A. B shows presence of a steady 1.2 kHz signal; C is a 15 Hz flickering to indicate that the SYNC signal is in tune.

be connected to the high side of the SYNC gain control (R1 of the MacDonald circuit). High voltage for the indicator is taken from the same voltage as that supplied for the 12AX7 limiter. With a 1200 Hz test signal connected to the input of the monitor, of sufficient level to fully saturate the limiters, the gain control on the tuning indicator is adjusted until the two light bars in the display tube almost close. When a 1200 Hz SSTV SYNC signal is being received, the display on the 6FG6 tube will flicker at a 15 Hz rate. Maximum deflection of the flickering display indicates that carrier reinsertion by the SSB receiver is at the proper frequency for optimum SSTV picture reception. Typical displays as seen on the tuning indicator are shown in Fig. 2.

Figures 3 and 4 are photographs of the tube-type monitor showing the installation of the light-bar SSTV tuning indicator. The small circuit board just below the base of the tuning indicator tube is used to mount the gain control, bypass capacitor and rectifier. The remainder of the components are mounted on the tube socket.

LED Tuning Indicator

The components for this circuit were mounted on the plug-in circuit card containing the limiter and FM detector circuits. The 88 mH toroid and associated parts for the tuning indicator circuit are shown in the photograph of Fig. 5. When the circuit assembly is finished, power is applied to the circuit and a 1200 Hz test signal is connected to the input at point B

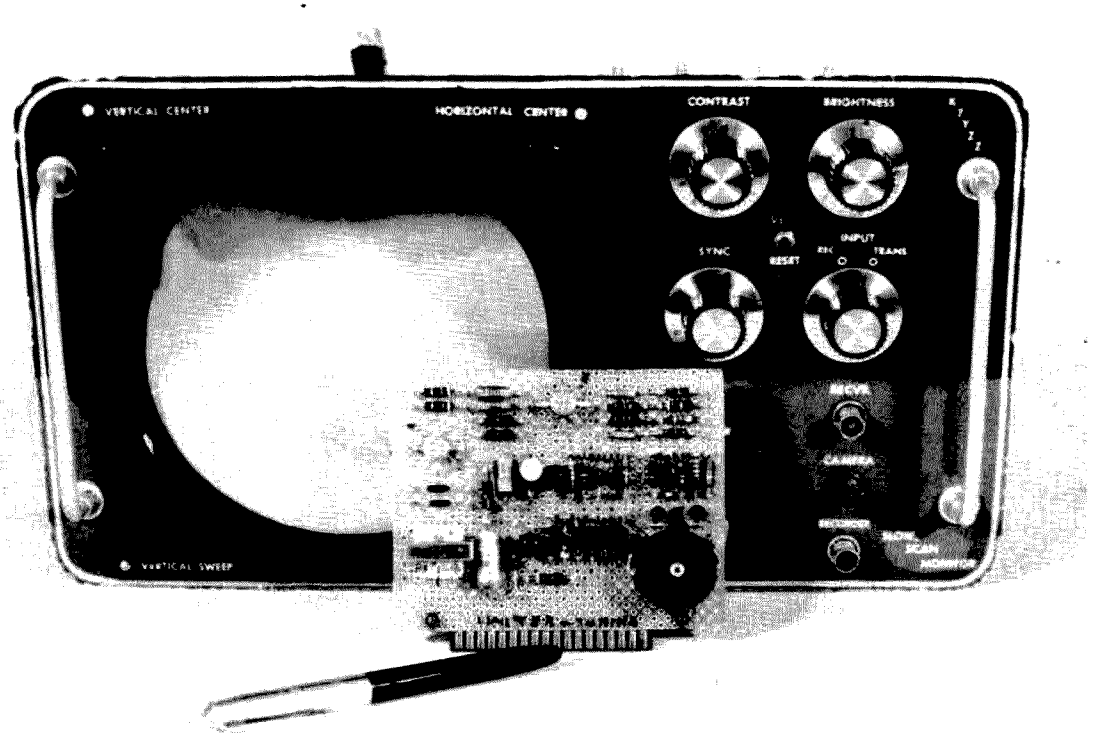


Fig. 3. Tuning indicators for SSTV monitors.

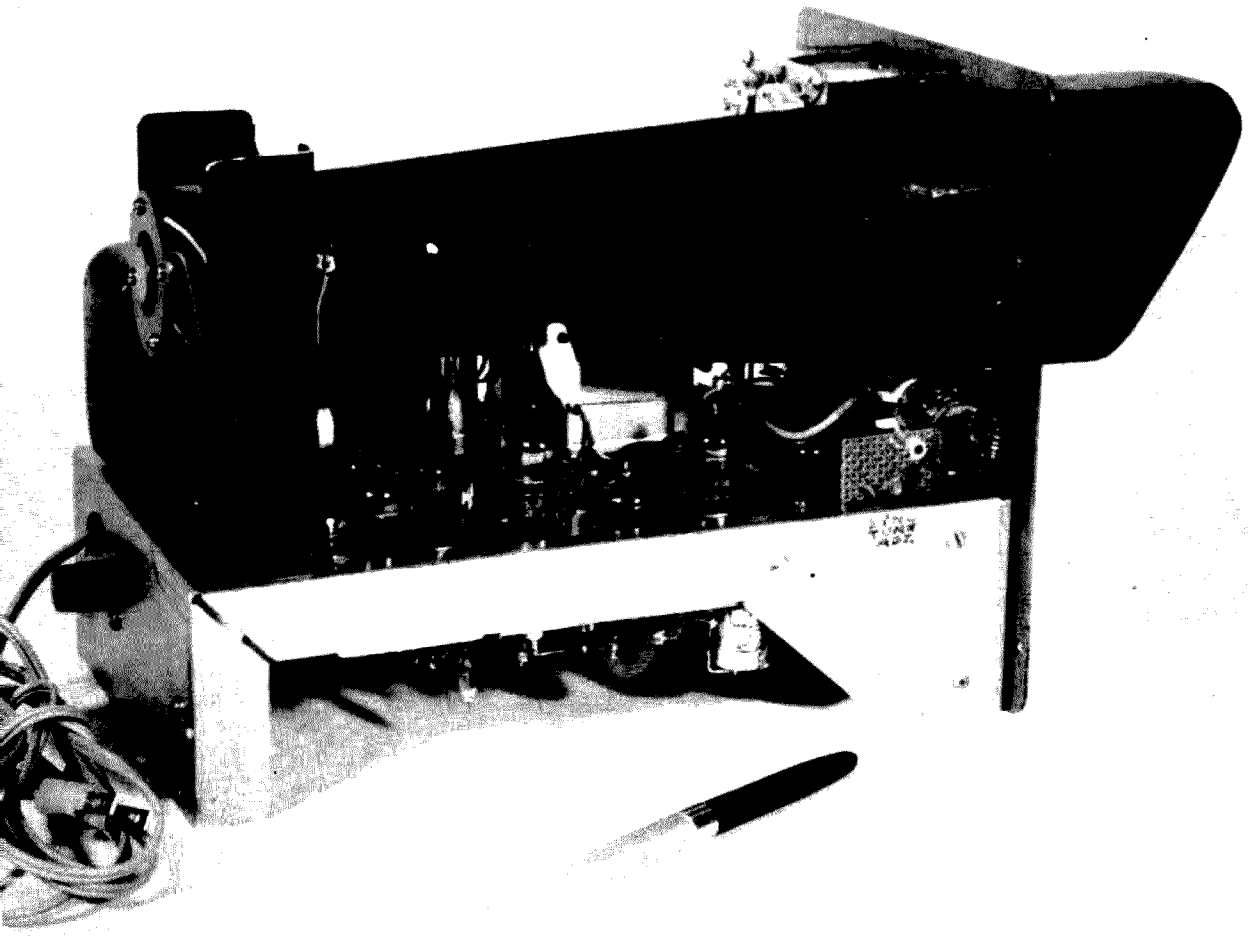


Fig. 5. Tuning indicators for SSTV monitors.

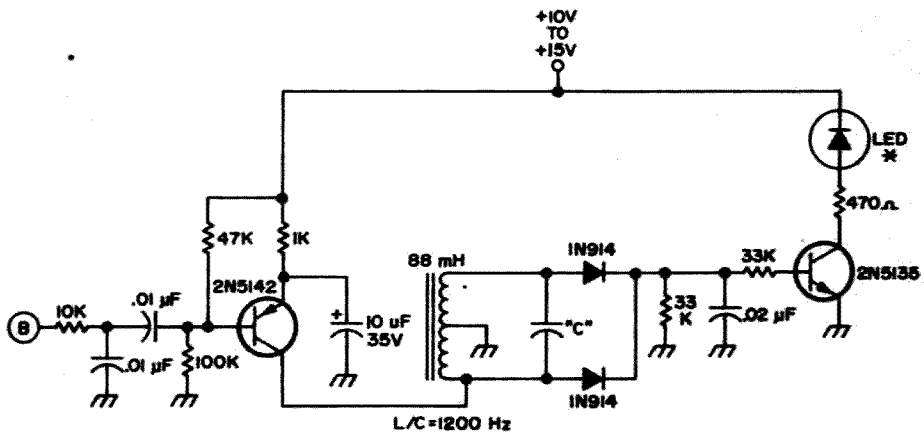
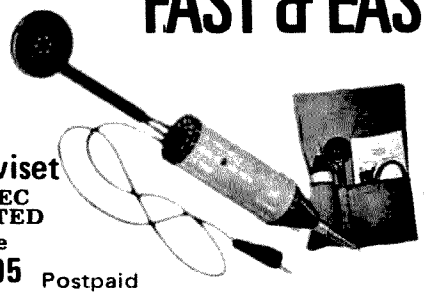


Fig. 6. SSTV LED tuning indicator for solid-state type monitors.

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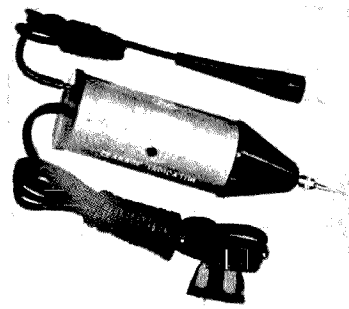


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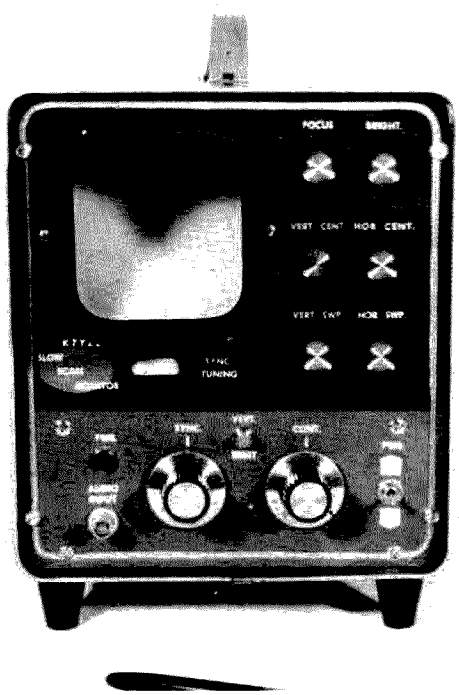


Fig. 4. Tuning indicators for SSTV monitors.

on the schematic (Fig. 6). The capacitor is selected to resonate the 88 mH inductor to 1200 Hz by monitoring the output voltage developed across the diode load resistor with a VTVM.

To install the LED tuning indicator in a solid-state monitor such as the model by W9LUO described in the March 1971 QST, connect input point B to the collector of transistor Q2. A 1200 Hz SSTV SYNC signal will cause the LED to flicker at the 15 Hz rate. The indicator will be dark if the SYNC signal is absent. When the receiver is mistuned to the point that SSTV video or noise is appearing in the tuning indicator, the LED will flicker at a random rate.

From a study of the schematic of the Model 70 Robot SSTV Monitor it looks like the input to the LED SSTV tuning indicator (point B) should be connected to pin number 6 of the integrated circuit U1 709C limiter.

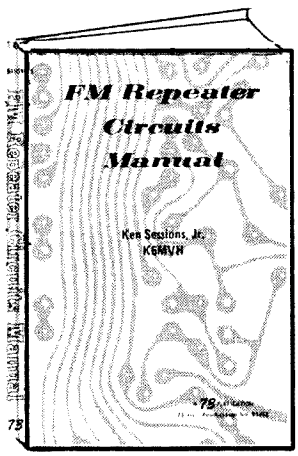
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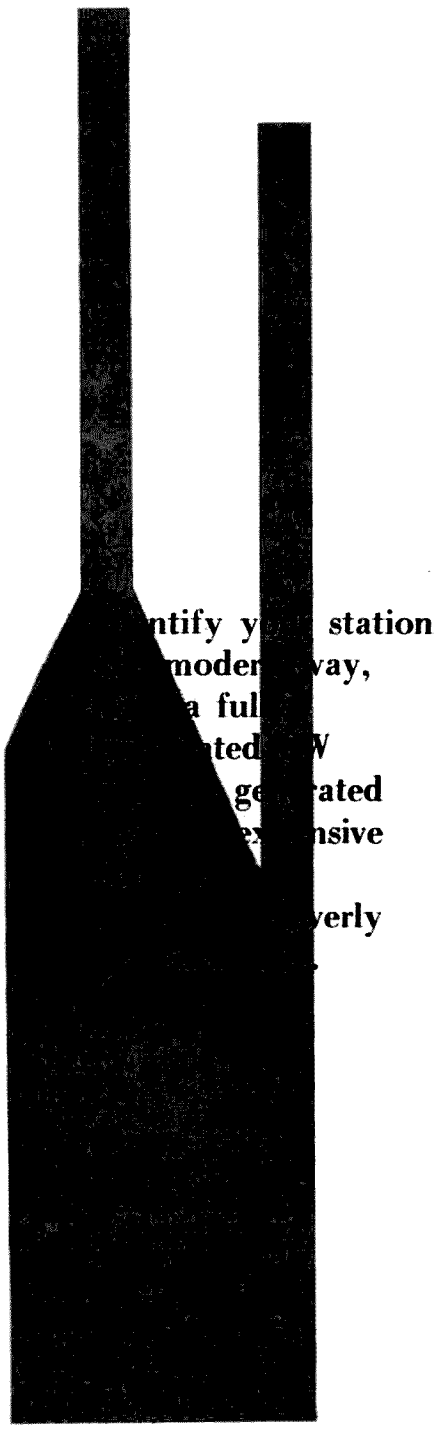
LET'S REVISE The MORSE CODE

I've just read Ford's article of the same title in the November issue of 73 and it is wonderful, well thought out, logical and should be adopted immediately; also we should end poverty and war. In other words, no matter how good an idea is, if it involves something new or different it is a dirty communistic plot to violently overthrow the status quo.

What we need is a system that will take the present equipment and make it work more efficiently. Now, although I could have thought of this all by myself, if given time, the credit should really go to some other guy. Let me explain. When I bought my TG34 code machine there were four tapes with it and one was a skip tape. A skip tape is one where every letter is sent at the 20 wpm rate but there is about a four second pause between letters so the Novice can say, "What the hell was that?" and have time to think about it before the next letter rushes at him. As Ford points out, code is an audio response phenomenon and letters sent slowly do not sound anything like letters sent fast. But it is just as easy to learn the fast letters as it is to learn the slow letters – in fact I think it is easier.

Now hear this – here is the secret of the Morse code – free. To send code everyone should set his bug or IC keyer to the 20 wpm speed. To send five words per minute you pause between letters to allow time to think, and you wait longer between words for the person copying to take a breath and all this time he is learning what the 20 wpm letters sound like. Believe me, it is easier to receive with this system because the complete letter goes into your mind's shift register very rapidly and you have more time to search your memory before the next letter arrives. It works; you will be astounded at the rapid progress you will make. Try it with the next Novice you work and see for yourself. . . .WB6JNI

MATRIX



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If you are a regular reader of 73 Magazine, you have undoubtedly noticed that a large number of articles have appeared covering the various aspects of amateur 2 meter FM operation. The intent of these articles has been to entice you to give FM a try. Many people have been involuntarily bitten by the FM bug. I am no exception. I have found a large amount of personal satisfaction in designing and building digital circuits for use in conjunction with a 2 meter repeater. Through this endeavor I have been able to learn about several different fields: Touch-Tone, discrete components, and integrated circuits.

Perhaps one of the more surprising things that happen when you start to investigate a new field is the large number of new techniques you are compelled to investigate and learn. My pursuit of control circuits for an FM repeater has lead me into several textbooks dealing with the subject of switching theory as it applies to the design of digital circuits.

The repeater that I have been working on for the past 6 months consists of a large number of Sylvania TTL integrated circuits that were purchased on the surplus market at a cost of 10 cents per flatpack.

There is more to building a device than removing the components from the original circuit board.

In digital design I have found that one frequently starts with a rather simple block diagram of the device desired and then proceeds to draw the detailed logic diagram consisting of the various *nand* and *nor* gates required to accomplish an objective. It is frequently useful to express some of the relationships mathematically using Boolean algebra. If you have mastered the subject you can then apply simplification rules to the equations to produce a less complicated statement of the problem. This is desirable because as you reduce the complication of the equation, you are in effect reducing the number of devices that will be required in the final circuit you construct. A simplified equation will lead to several benefits which come about as a result of less components:

1. Lower cost
2. Decreased construction time
3. Smaller area through less wiring and interconnection
4. Increased reliability
5. Simplified schematics
6. Lower power consumption

The September 1970 issue of 73 described P. J. Ferrell's digital circuit that was used to automatically generate the CW identification for a repeater located in Seattle, Washington*. His call-letter generator consists of a five-digit ripple counter which is used to control the characters generated. When you design the unit, you are basically saying things like this:

1. I want a dot when the counter equals 0.
2. I want a dash when the counter equals 1.
3. I want a dash when the counter equals 2.
4. I want a space when the counter equals 3.
5. I want a dot when the counter equals 4.
6. I want a space when the counter equals 5.
7. Etc.

If you examine the above statements you will be able to see that what has been specified is the sequence dot dash dash blank dot dash . . . in terms of a sequential counter. The basic logic problem becomes one of specifying when the dots, dashes, and blanks are required as a function of the value existing in the counter. One way is to use a lot of gates or diodes to in effect say, "If the binary pattern in the counter is 1 1 0 1 1 then I want a dash; if the binary pattern is 1 0 1 0 0 then I want a dot." This would imply that you would need a lot of gates with 5 inputs if you wanted to get the job done. When I was faced with this problem, I went to the textbooks and was glad to discover that someone else had already faced the problem and solved it for me!

The original article suggested the use of a Karnaugh map for minimizing the number of diodes required in the read-only diode memory. Karnaugh maps are helpful in many instances, particularly when the number of variables is four or less. Many people find that when there are more than four variables the map becomes rather difficult to understand. Of course, the world does have map experts but what amateurs need is a simpler approach to the

CHARACTER STREAM	COUNT	DECIMAL FF A	FF B	COUNTER FLIP FLOPS FF C	FF D	FF E	FF F	1's
blank	0	0	0	0	0	0	0	0
—	1	0	0	0	0	0	1	1
•	2	0	0	0	0	1	0	1
•	3	0	0	0	0	1	1	2
blank	4	0	0	0	1	0	0	1
•	5	0	0	0	1	0	1	2
blank	6	0	0	0	1	1	0	2
blank	7	0	0	0	1	1	1	3
blank	8	0	0	1	0	0	0	1
•	9	0	0	1	0	0	1	2
—	10	0	0	1	0	1	0	2
—	11	0	0	1	0	1	1	3
blank	12	0	0	1	1	0	0	2
•	13	0	0	1	1	0	1	3
—	14	0	0	1	1	1	0	3
blank	15	0	0	1	1	1	1	4
—	16	0	1	0	0	0	0	1
—	17	0	1	0	0	0	1	2
—	18	0	1	0	0	1	0	2
—	19	0	1	0	0	1	1	3
—	20	0	1	0	1	0	0	2
blank	21	0	1	0	1	0	1	3
—	22	0	1	0	1	1	0	3
—	23	0	1	0	1	1	1	4
•	24	0	1	1	0	0	0	2
•	25	0	1	1	0	0	1	3
blank	26	0	1	1	0	1	0	3
•	27	0	1	1	0	1	1	4
•	28	0	1	1	1	0	0	3
•	29	0	1	1	1	0	1	4
•	30	0	1	1	1	1	0	4
blank	31	0	1	1	1	1	1	5
—	32	1	0	0	0	0	0	1
blank	33	1	0	0	0	0	1	2
blank	34	1	0	0	0	1	0	2
blank	35	1	0	0	0	1	1	3
—	36	1	0	0	1	0	0	2
•	37	1	0	0	1	0	1	3
—	38	1	0	0	1	1	0	3
blank	39	1	0	0	1	1	1	4

Fig. 1. Basic count values and other data.

*"Integrated Circuit CW ID Generator, P.J.Ferrell 73 Magazine, September 1970, p. 16.

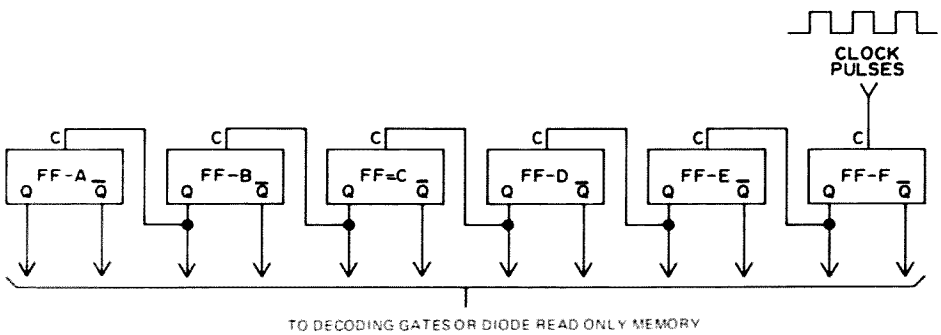


Fig. 2. Ripple counter described in text.

problem of simplification of counter decoders.

The Tabular Method

Several textbooks describe a method that requires a fair amount of clerical work but only a limited amount of real thinking. I chose to use that method. The discussion that follows is aimed at showing you how to apply the "Tabular Method" to simplify counter decoders. (An excellent discussion of the method, with some sophisticated extensions, exists in "Switching Circuits for Engineers," by Mitchell P. Marcus.)

So that you can better understand the relevancy of the Tabular Method, let us analyze the decoding necessary for constructing a digital CW code identifier having a 6-bit counter. Although most amateur calls can be described without resorting to more than 32 different characters (dots, dashes, and blanks), let's generate a fancy message. (Note that *any* message could be generated, e.g., RST 589 IOWA K.)

When the call is to be transmitted, your system will probably cause a push-to-talk relay to be activated. Consequently, it would be nice to begin the message with a blank to give the relay time to pull in. If the identifier is used in a complex system that supplies dial tone to its users, it may also be desirable to have a blank at the end so that the CW does not "run into" the dial tone. If you put these thoughts together, you will have a message that closely resembles the one described in Fig. 1.

Figure 1 contains additional information that will be referred to in different stages of our discussion of the simplification procedure. You should notice at this point that each character that composes the message has been paired with the value that would be in the counter when the character was to be generated. The value of the counter is shown in decimal and also in binary for your conversion convenience.

The zeroes and ones in Fig. 1 represent the binary equivalent of the decimal numbers shown in the "decimal count" column. A zero means that the associated flip-flop is *reset* while a one means that the flip-flop is *set*. (Some manufacturers refer to the outputs as Q and $\overline{Q}$, corresponding to true and false; Q = true = 1 and $\overline{Q}$ = false = 0.) For convenience in referencing the flip-flops that compose the various stages of the counter, the flip-flops are designated as A, B, C, D, E, and F (See Fig. 1). If flip-flop A is in the set, or true, state, we will write the letter A; however, if flip-flop

Original	New-A	New-B
000000✓	000x00✓	00xx00*
- - - - - -	00x000✓	~~00xx00~~
000100✓	- - - - - -	
001000✓	0001x0*	
- - - - - -	00x100✓	
000110✓	001x00✓	
001100✓	- - - - - -	
100001✓	00011x*	
100010✓	1000x1*	
- - - - - -	10001x*	
000111✓	- - - - - -	
010101*	00x111*	
011010*	x00111*	
100011✓	100x11*	
- - - - - -	- - - - - -	
001111✓	0x1111*	
100111✓		
- - - - - -		
011111✓		

Fig. 3. Values and reduction for blanks.

BLANKS

	A	B	C	O	E	F	G	H	I	J	K	L	M	N
	000000	000100	001000	000110	001100	100001	100010	000111	010101	011010	100011	001111	100111	011111
0001x0		✓		✓										
00011x				✓				✓						
1000x1						✓					✓			
10001x							✓				✓			
00x111								✓				✓		
x00111								✓					✓	
100x11											✓		✓	
0x1111												✓		✓
00xx00	✓	✓	✓		✓									
010101									✓					
011010										✓				

Fig. 4
Tabular display for blanks.

A is in the reset, or false, state, we will write $\overline{A}$ (read "A not"). Figure 2 shows the simple counter used in our discussion.

You should notice that the binary expression of the count shows that a 6-stage counter is being used. This means that you could have as many as 63 characters in the message (saving the last value of the counter for stopping the sequence). The counter has 64 unique states, 000000 through 111111.

The Tabular Method can be used to help simplify logical states for various applications but if we address our attention just to the CW identifier previously mentioned, then what we want in this case is a simplified statement of when we need dots and when we need blanks (the character generator circuitry produces dashes unless programmed to generate something else). The equations that result from the simplification can be used to specify the gates that must be used if you choose to decode the counter with integrated circuits. Since W7PUG's system used a read-only diode memory, I will address this discussion to that mode of implementation and show you how the Tabular Method will minimize the number of diodes required and produce a wiring map for use in constructing the decoder. For this example I chose a "fancy" message so that the counter would have to be composed of 6 stages rather than only 4 or 5.

Since the circuitry generates dashes automatically, we have to generate expressions for only the dots and the blanks. The Tabular Method proceeds as follows:

Expression for Blanks

We begin by extracting from Fig. 1 the binary values of the counter corresponding to when we need to have blanks generated. This produces the list of values shown in Fig. 3. As the list is made, we arrange the values so that values with the same number of 1's are grouped together. (The rightmost column in Fig. 1 is used to facilitate this listing.) The values are segmented with broken lines to show those numbers having no 1's, one 1, two 1's, etc. In the case of the blanks you see that there are six basic groups of values.

The method now requires that each of the values in a particular group be compared to each value in the next group. In Fig. 3, this means that 000000 will be compared to 000100 and 001000; 000100 and 001000 will be compared to 000110, 001100, 100001, and 100010. The comparison operation consists of seeing if it is possible to derive the second number from the first number by changing only a single digit position. When 000000 is compared to 000100 you should see that you can get 000100 from 000000 by changing the digit that is in the fourth position from the left. Consequently, these two values give rise to a new value written as 000x00 (The x

shows the position that was changed to make the second value.) This new value is written into a new list shown in Fig. 3 as new-A. Comparing 000000 with 001000 yields a new entry of 00x000 in list new-A.

When a value is used in one of the comparing operations, and an entry is made in a new list, the original values are checked off. You will note that Fig. 3 shows that all but two of the original values were used in this combining operation. Each time a new group of numbers are used as "the first number," a separating line is drawn in the new list. Additional new lists are made until no further combinations can be made. Figure 3 shows the complete set of lists for the analysis of blanks. The values that do not combine are not checked but have been suffixed with an asterisk (*) to indicate that they are to be used in the next step of the simplification.

When the comparisons have been completed, a tabular display such as that shown in Fig. 4 is prepared. The column headings consist of the original counter values that were supposed to produce blanks. A row is added for each value that was suffixed with an asterisk when the comparisons were made. For each of the values shown to the left of a row, we now make an examination to determine the original terms which can be "generated" from the terms identifying the rows. The "generation" consists of

Rule 1 . . . A column, a, can be eliminated from the table if it has checks in every row that some other column, b, has checks. (The subset is saved.)

Rule 2 . . . . A column, a, can be eliminated if it has checks in the same rows as another column, b. (Given two identical columns, one can be eliminated.)

Rule 3 . . . . A row, z, can be eliminated if some other row, y, has checks in every column that z has, AND the number of 0's and 1's in z is equal to or greater than the number of 0's and 1's in y.

Fig. 5. Simplification rules.

replacing the x or x's with both 0 and 1 and then checking off the original terms created. For example, if we take the first row, with 0001x0 we can generate 000100 by substituting 0 for x and we can generate 000110 by substituting 1 for x.

We now place check marks beneath the original terms generated; 000100 and 000110. Applying the same process to an entry such as 00xx00 would produce these original terms: 000000, 001000, 000100,

BLANKS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	000000	000100	001000	000110	001100	100001	100010	000111	010101	011010	100011	001111	100111	011111
0001x0		✓		✓										
00011x				✓				✓						
1000x1						✓					✓			
10001x							✓				✓			
00x111								✓				✓		
x00111								✓					✓	
100x11											✓		✓	
0x1111												✓		✓
00xx00	✓	✓	✓		✓									
010101									✓					
011010										✓				

Fig. 6. Tabular display for blanks after application of reduction rules.

and 001100. The columns corresponding to each of these original values has a check mark opposite 00xx00. If the term contains no x's, for example 011010, then you place a check mark in only one column. When all of the check marks are in place, the table is ready to be simplified by the application of a few simple rules. Figure 4 shows the table with all of the check marks entered properly.

Figure 5 lists the rules that are applied to the table to perform the actual reduction. Let's apply these rules to Fig. 4 and produce the slightly modified form shown in Fig. 6.

For ease of identification, the columns in Figs. 4 and 6 have been labeled with letters of the alphabet. Rule 1 can be applied to columns L and N thereby eliminating column L. Rule 1 can be applied to columns G and K thereby eliminating column K. Rule 1 can be applied to columns A and B, thus eliminating column B. Rule 2 can be applied to columns A, E and C, thereby eliminating columns C and E.

Figure 6 shows with shading the columns that have been removed from the table. The object of this last step is *hopefully* to eliminate rows in the table. In this particular case, no rows were eliminated. Had rows been eliminated, the corresponding terms would be dropped during the next step of our simplification.

The final step in the simplification is to write a statement for the quantity of interest. This simplification was for blanks so we will write a statement which combines the terms opposite rows that were *not* eliminated from the table. The result that we get is as follows:

BLANKS = 001x0 or 00011x or 1000x1 or 10001x or 00x111 or x00111 or 0x1111 or 00xx00 or 010101 or 011010

You should recall that the binary values correspond to the state of the flip-flops A, B, C, D, E, and F. We can thus rewrite the statement by replacing the 0's and 1's with the appropriate flip-flop designator and simply dropping the x's. Doing this, 0001x0 becomes $\overline{A}\ \overline{B}\ \overline{C}\ D\ \overline{F}$. The resulting equation for blanks is thus:

	New-A	New-B
000010	00001x*	0x1x01*
------	------	0x1x01
000011	00x101*	011x0x*
000101	x00101*	011x0x
001001	001x01	
011000	0x1001	
------	01100x	
001101	011x00	
011001	------	
011100	0x1101	
100101	0110x1*	
------	011x01	
011011	01110x	
011101	0111x0*	
011110		

Fig. 7. Values and reduction for dots.

BLANKS = $\overline{ABCD}\overline{F}$ or $\overline{ABC}DE$ or $A\overline{BCD}F$ or $A\overline{BCD}E$ or $\overline{AB}DEF$ or $\overline{BC}DEF$ or $A\overline{BC}EF$ or $\overline{A}CDEF$ or $\overline{ABE}F$ or $\overline{A}BC\overline{D}\overline{E}F$ or $\overline{A}BC\overline{D}EF$

In order to implement this equation, one diode will be required for each of the *or*'s for a total of 10 diodes. For each of the terms in the equation, there will be one diode per flip-flop named. Thus $\overline{ABCD}\overline{F}$ will require the use of 5 diodes. There will thus be 56 diodes for the terms and 10 for the *or*'s for a total of 66 diodes. If we had not simplified, there would have been one diode for each value of the counter (14) plus 6 diodes for each value (6 x 14 = 84) or a total of 84 + 14 = 98 diodes. Application of the Tabular Method has thus reduced the number of diodes by approximately 30% – a 30% savings in parts and wiring! The savings that you will realize varies with the complexity of the message.

Expression for Dots

To be sure that you understand the simplification method, let's apply the technique to the values for dots.

Figure 7 shows the binary values that have been removed from Fig. 1 and listed in groups based upon the number of 1's in the values. You will notice that this time we have only 4 groups of values. As in the

DOTS

	A	B	C	D	E	F	G	H	I	J	K	L
	000010	000011	000101	001001	011000	001101	011001	011100	100101	011011	011101	011110
00001x	✓	✓										
*00x101			✓			✓						
x00101			✓						✓			
0110x1							✓			✓		
0111x0								✓				✓
0x1x01				✓		✓	✓				✓	
011x0x					✓		✓	✓			✓	

**ROW HAS BEEN ELIMINATED BY APPLICATION OF RULES

Fig. 8. Tabular display for dots.

previous example, the simplification begins by comparing 000010 to 000011. This comparison yields the entry 00001x in the second table. None of the remaining values in the second group can be derived from 000010 by changing only a single digit. The simplification continues by comparing all of the values in the second group to the values in the third group. These comparisons generate the new values 00x101, x00101, etc. In this case, by the time all of the group comparisons have been made, all of the original values have been used at least once and are therefore suffixed with a check mark. The values in the new table (new-A in Fig. 7) are then compared and used to generate new values when possible. You should note that when values involving x's are compared, it is necessary that the two values contain x's in the same positions *before* you check to see if the second value can be derived from the first value by changing a single zero or one. Figure 7 shows that the final result consists of 7 terms with asterisks. The next step is to construct the tabular display of the original values and the asterisked values derived from the comparisons. Figure 8 shows such a table.

The next step is to place a check mark in the column or columns corresponding to the original values that can be derived from the asterisked terms. Figure 8 shows the completed table. Once again we must now apply the three rules shown in Fig. 5 to check marks in the tabular display.

Rule 1 can be applied to columns C and I thereby eliminating column C. Rule 1 can be applied to columns D and F thereby eliminating column F. Rule 1 can be applied to columns E, G, H, and K thereby eliminating columns G, H, and K. Finally, rule 2 can be applied to columns A and B thereby eliminating column A. We can now write a statement for dots in terms of the asterisked terms that still have at least 1 check mark in their row. The statement is:

DOTS = 00001x or x00101 or 0110x1 or 0111x0 or 0x1x01 or 011x0x

The statement is next written in terms of the flip-flop designators previously defined (A, B, C, . . .).

DOTS = $\overline{A}BC\overline{D}E$ or $\overline{B}C\overline{D}\overline{E}F$ or $\overline{A}BC\overline{D}F$ or $\overline{A}BCD\overline{F}$ or $\overline{A}C\overline{E}F$ or $\overline{A}BC\overline{E}$

As in the case for the blanks, one diode will be required for each term to be *or*ed

	WITHOUT SIMPLIFICATION	WITH SIMPLIFICATION	REDUCTION
BLANKS	98	66	30%
DOTS	84	34	60%
TOTAL	182	100	45%

Fig. 9. Diode count.

plus one diode will be required for each flip-flop mentioned in each term. The decoding for the dots will therefore require 6 + 28 = 34 diodes. Without simplification, the decoding would have required 84 diodes (12 + 72). Notice again that the

	FF-A	FF-B	FF-C	FF-D	FF-E	FF-F
00001X	0	0	0	0	1	X
X00101	X	0	0	1	0	1
0110X1	0	1	1	0	X	1
0111X0	0	1	1	1	X	0
0X1X01	0	X	1	X	0	1
011X0X	0	1	1	X	0	X

Fig. 10. Wiring map for dots

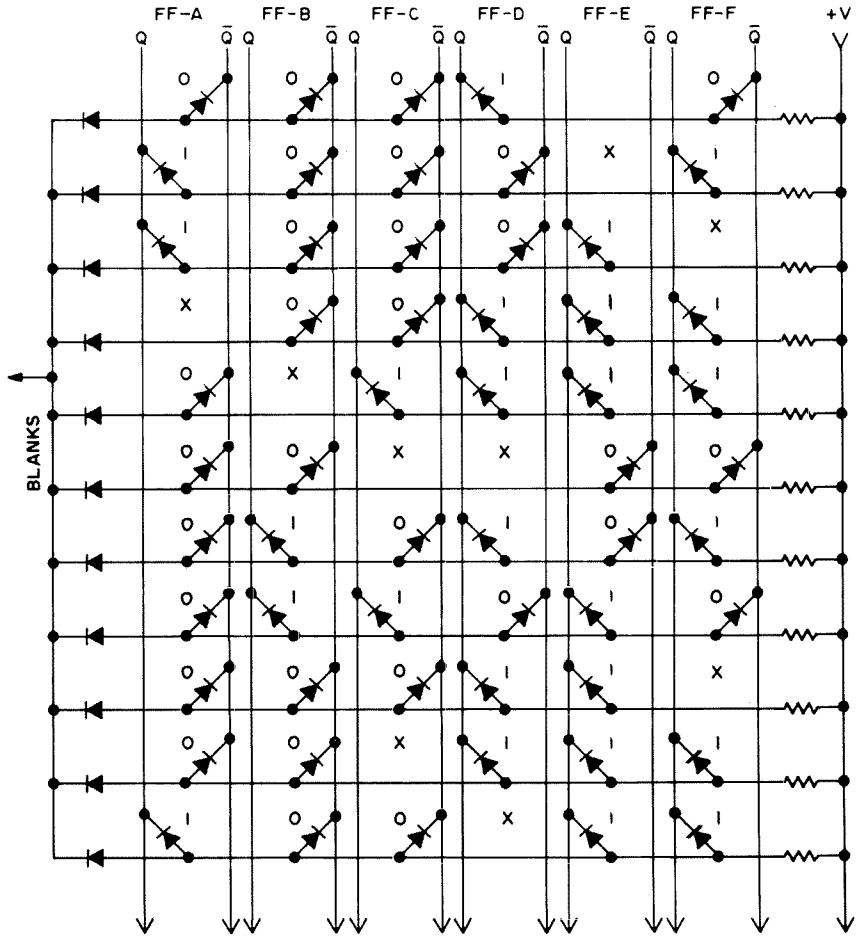


Fig. 11. Wiring map for blanks.

simpliciation has been well worth the effort!

If we take a look at the total problem we see that simplification has been very worthwhile. Figure 9 shows the diode count with and without simplification.

To complete our discussion, let us address ourselves to the proper interpretation of the equations as they apply to the actual wiring of the read-only diode memory. It is helpful to construct a "map" that will help you find your way around the wiring details.

Figure 10 is the wiring map for dots. Across the top of the map you will see the flip-flop designators. The various rows correspond to the individual terms that are in the reduced equation. Take an equation such as:

DOTS = 00001x or x00101 or 0110x1 or 0111x0 or 0x1x01 or 011x0x

For each of the terms, enter one row into the map. The 0's represent a diode connected to the false output of the flip-flop while the 1's represent a diode connected to the true output of the flip-flop. Where there are X's, no diodes are required. The map can thus be described by simply displaying the terms of the equation in a list! Such a wiring map is useful when you start to construct your decoder. Figure 11 shows the map with the diode wiring schematic superimposed to help you see the map's usefulness for wiring the blanks decoder.

In this discussion I have introduced you to a method of simplification that is not difficult and yet is flexible enough to allow easy simplification of count registers having many digits.

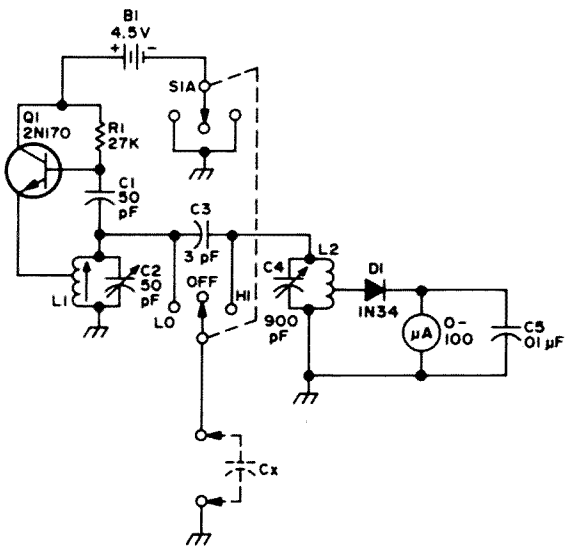
As a final testament to the method's utility, I have applied the principles described herein to my 5-digit counter and have an identifier running that flawlessly generates my call! Why not build yourself an identifier? You might include several decoders to generate signal reports, ARRL section, etc. for field day use!

...WAØZHT

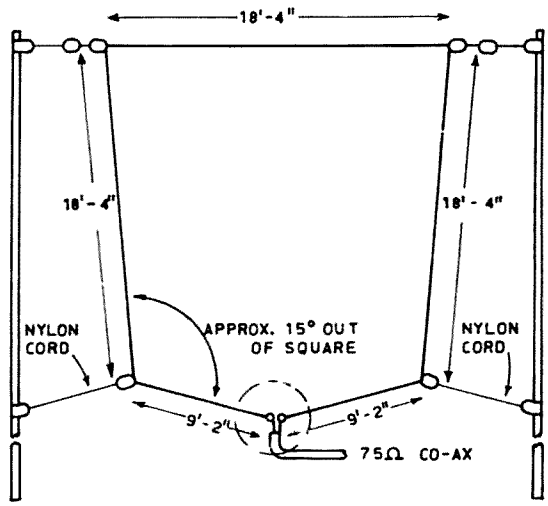
CIRCUITS, CIRCUITS, CIRCUITS...

The following circuits have appeared in the referenced books, magazines, application notes, etc. While we try to reproduce all of the information that should be needed by an experienced constructor, readers may want to avail themselves of the original sources for peace of mind.

Readers are requested to pass along any interesting circuits that they discover in sources other than U.S. ham magazines. Circuits should be oriented toward amateur radio and experimentation rather than industrial or computer technology. Submit circuit with all parts values on it, a very brief explanation of the circuit and any additional parts information required, give the source and a note of permission to reprint from the copyright holder, if any, and the reward for a published circuit will be a choice of a 73 book. Send your circuits to 73 Circuits Page, 73 Magazine, Peterborough NH 03458.

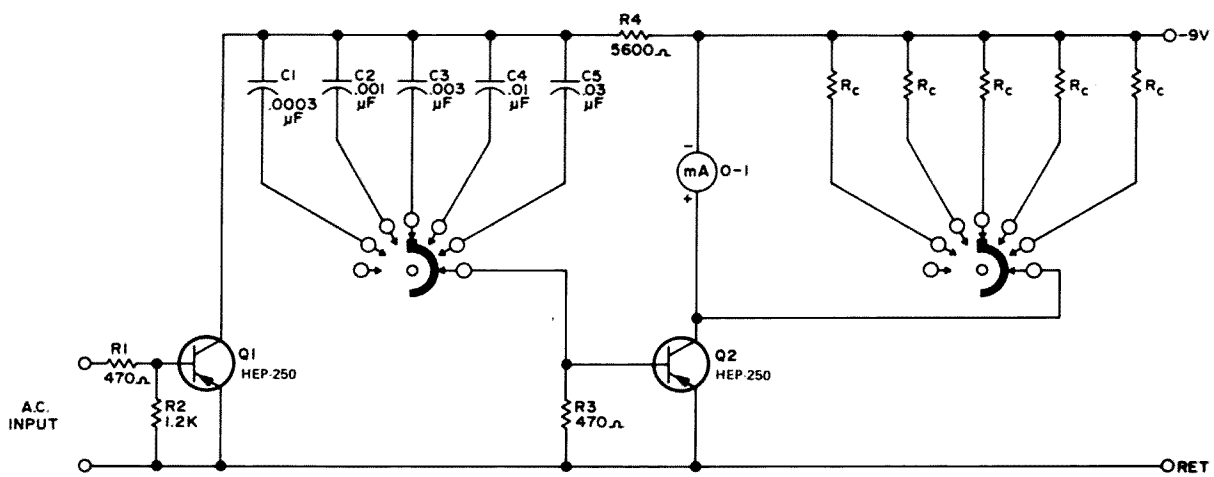


Capacity Meter. From Dec. 60 73 p15. L1-C2 and L2-C4 should tune to the same frequency, around 1450 kHz. Calibrate by setting C4 near max and mark that "zero." Peak meter with C2, which is zero adjustment. Calibrate with known capacities and mark C4 dial.

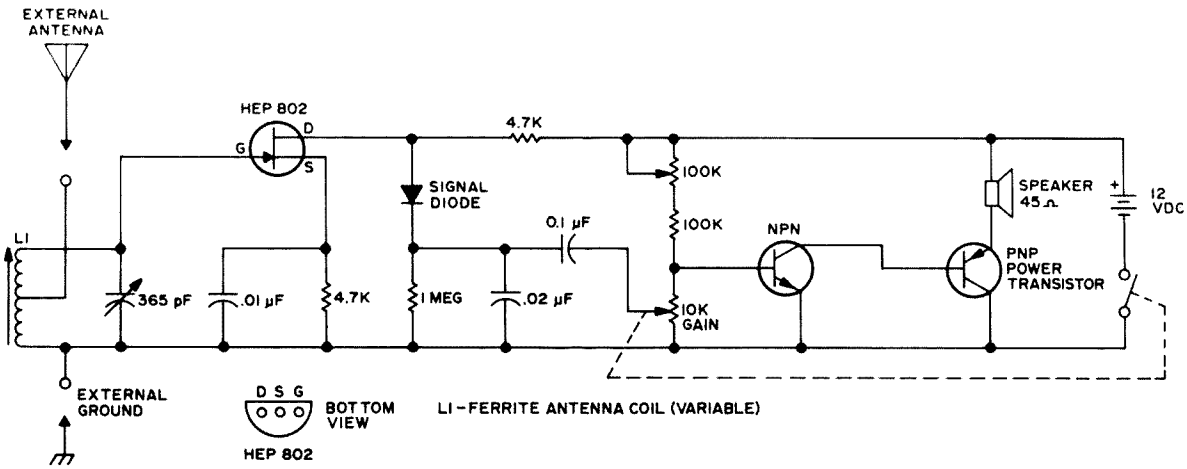


VK2AAR Wire Antenna

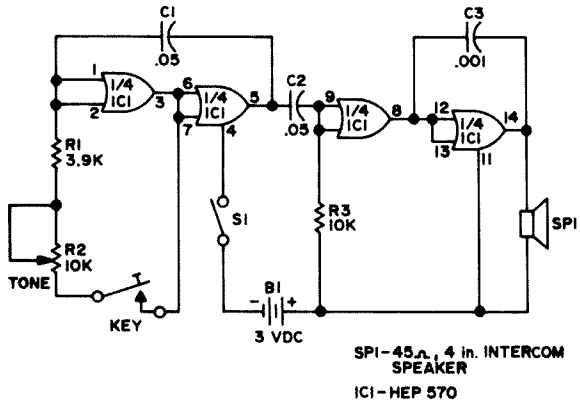
Works best on 20m, with higher (but not unreasonable) swr on 40 & 80m (3:1). Note bottom section drags sides in about 15°, a critical dimension that may require experimenting. Antenna courtesy Amateur Radio July 71. Wireless Institute of Australia, Box 36, East Melbourne, Vic. 3002.



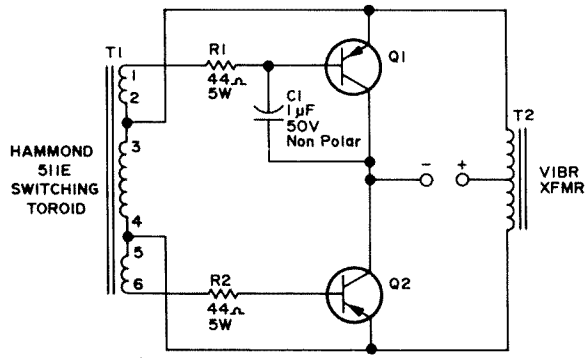
From 73 Magazine, November 1960, this schematic gives the basics for a simple, inexpensive audio frequency meter. For the cheapie special version, omit all switches and components associated with them. Connect a capacitor of proper value in place of S1A. Ranges are: OFF, 30 kHz, 10 kHz, 3 kHz, 1 kHz, and 300 Hz. Meter is 0–1 mA.



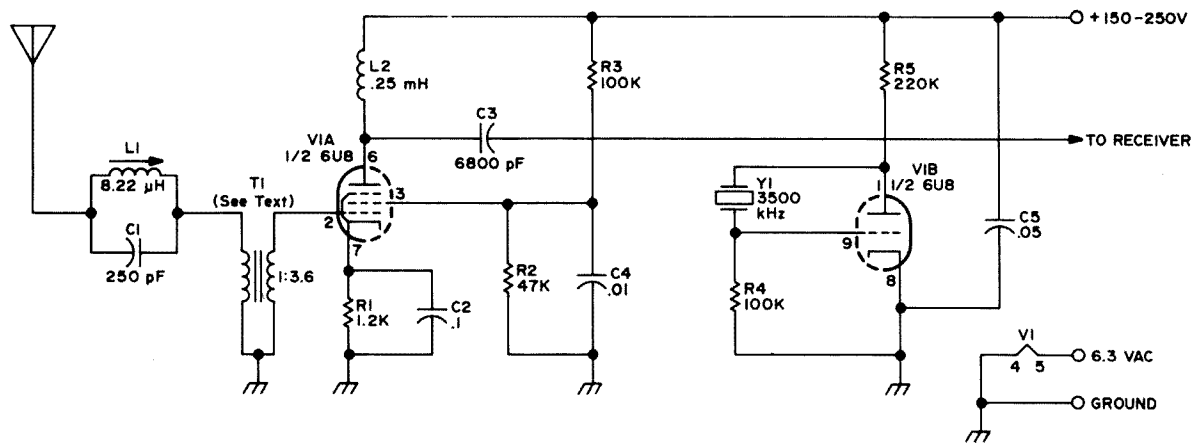
Three transistor radio (AM). Adjust R4 so voltage across speaker is 1/2 supply voltage. Works surprisingly well. Circuit courtesy Calectro Handbook. L1 is a ferrite antenna coil (variable) (Calectro #D1-841); Q2 is an NPN transistor (Calectro #K4-506); Q3 is a power PNP (Calectro #K4-521); D1 is a signal diode (Calectro #A1-227).



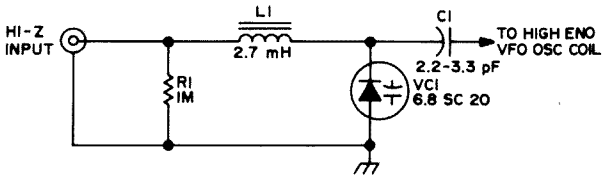
Code practice oscillator using one IC, loud. Intercom speaker may be replaced with a regular 4–8Ω speaker if a transformer is used to match the impedance down from 50Ω to 4Ω. Circuit is from Motorola HMA-36, Radio Amateur's IC Projects, available free from Motorola, Dept. 73, Box 20924, Phoenix AZ 85034.



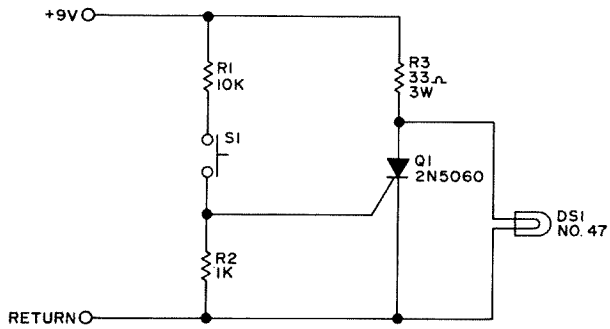
A transistor power supply for a vibrator-powered mobile rig. Called a "Plug-In Solid-State Vibrator Eliminator" by its designer, Vern Epp, it first appeared in FM Magazine, *and is reprinted from* The Best of FM, *available from Radio Bookshop, Peterborough NH 03458, for $4.95.*



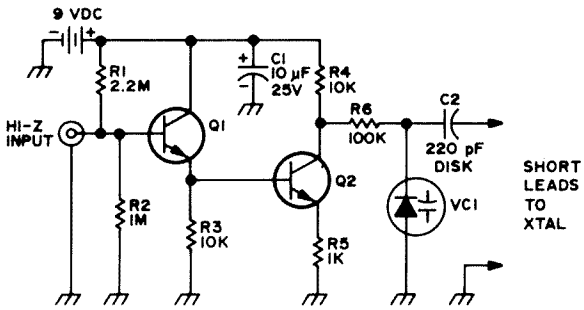
VLF converter, tuning 10 to 30 kHz. I-f is at the low end of the 80 meter band. From an article in 73 Magazine, July 1961.



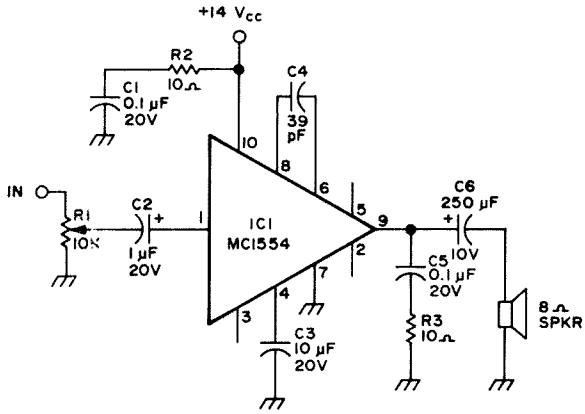
This varactor modulator will put your vfo-operated AM transmitter on FM in ten minutes. Assemble it on a standard three-terminal phenolic tiestrip and tuck it into a corner of your chassis. Both this modification and the one below for crystal controlled rigs should be driven with a high output, high impedance crystal or ceramic mike.



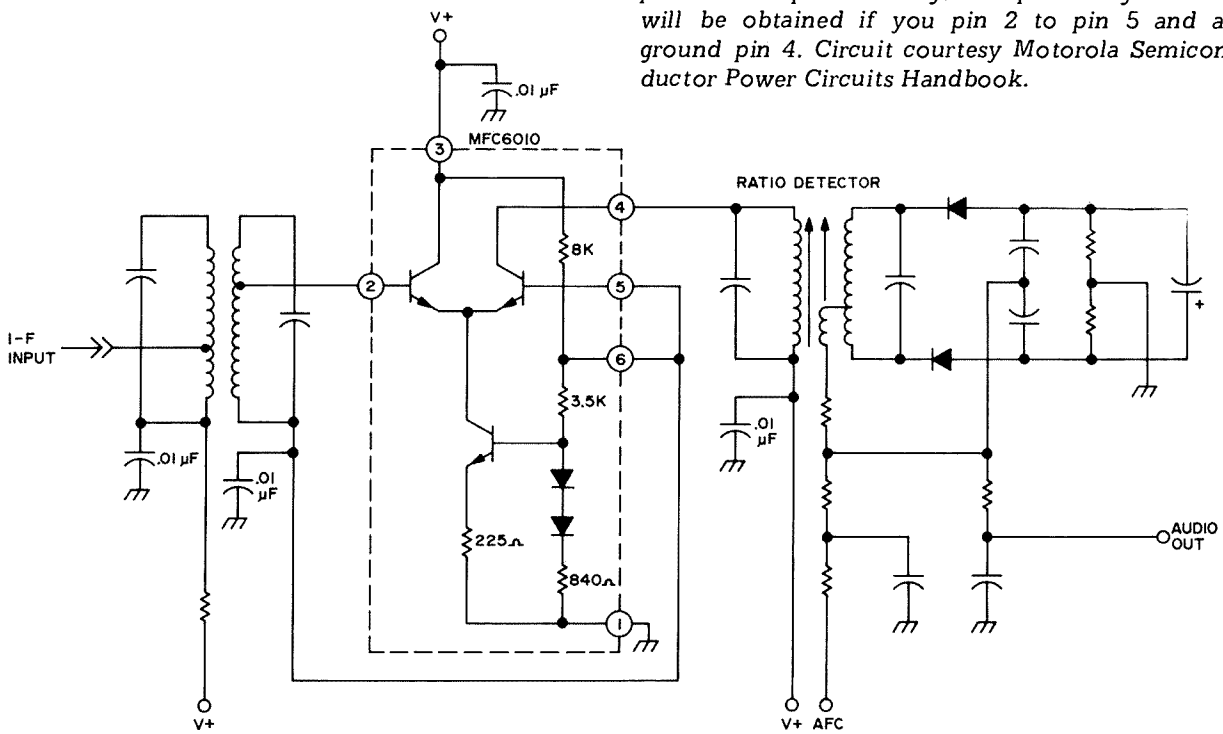
Interrupted-Power Indicator. Circuit courtesy Motorola Semiconductor Power Circuits Manual.



Use this device to put your crystal-controlled AM rig on FM. Both this schematic and the one above are from the 73 Inc. book, The Best of FM, *reprints from the now defunct* FM Magazine.



One watt audio amplifier using one IC. For a gain of 10 leave pins 2 & 4 open and ac ground pin 5 with the 10 µF capacitor. For a gain of 18 leave pins 2 & 5 open and ac ground pin 4. A gain of 36 will be obtained if you pin 2 to pin 5 and ac ground pin 4. Circuit courtesy Motorola Semiconductor Power Circuits Handbook.



10.7 MHz limiting amplifier, using the Motorola MFC6010, a monolithic silicon IC especially designed for 10.7 MHz i-f applications. Typical application schematic courtesy of Motorola Functional Circuits product bulletin.

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STEP TWO. In laying out the ad you should keep in mind that you need some sort of "grabber" to make sure that your ad, once seen, is actually read. VW does this with a big picture and a clever caption. Perhaps a picture will do it for you. Or maybe you can think up a good one-liner. Every ad in 73 is seen by every reader, but many go unread because they don't grab attention. Your ad is wasted if it isn't read, obviously.

Work your selling points into the copy and don't be afraid of running all the copy you need to get your point across. Once you have the attention of the reader you want to be sure that he understands why he cannot go another week without buying your unit, why he will have so much fun with it is worth all the problems he may have in getting it by the wife.

A professional picture of the product is extremely important. You're going to need that for spec sheets, brochures, etc., so you should get a good commercial photographer to do the job right for you. We can, if you are short of time, shoot a workable picture with our giant copy camera, but we don't have the facilities to do much more than a good front panel shot.

STEP THREE. Send a sketch of your ad along with the typewritten copy to 73. Include the photograph and any ink drawings or special artwork for the company name, cartoons, etc. This is due in our hands before the tenth of the month if it is to be sure and make the next published issue.

STEP FOUR. In a few days you will receive proofs of your ad as set up by the 73 Art Department. Make sure that everything is as you want it. Make changes sparingly at this time as there will be no further opportunity for checking a proof before publication.

STEP FIVE. As soon as the magazine is out with your ad in it you will receive a copy by first class mail. A few days later the orders will start coming in and then your problem is keeping up with business.

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Send your ads to Aline Coutu, 73 Magazine, Peterborough, N.H. 03458 and get ready to start filling orders.

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The Makings of a Modern Day Receiver

There was once a time – and when I first became a ham there were still a few oldtimers who could remember it – when the ham radio operator was, in fact as well as in name, an amateur of radio. His station was more than a mere investment of dollars and cents. It was the testimony of his skill. Rather than take the coward's way out, those hardy hams of yore built their rigs – from the ground up.

It's possible that I'm being a trifle unjust. Equipment has, since then, become far more complex, and construction techniques today require a costly array of tools and test equipment. Nonetheless, I feel that a ham isn't truly an amateur of radio unless he at least knows what's happening inside his rig. To the ham whose daily bread is earned in the electronics trade, such knowledge is a reality; but to the rest of the amateur world a twentieth-century receiver is nothing less than a magic box of mystery.

Now, it's a pretty safe assumption that even the Novice understands the operation of a basic superheterodyne. But what about the expensive complicated receivers now being advertised for the ham of today? Triple conversion, synthesizers, tuned i-f, product detectors, and other terrifying names go round and round in the head of a poor Novice struggling to comprehend the wiles and windings of the engineering marvel he just went hopelessly into debt to acquire. Oh, for the good old days when a guy could sit down and build an oscillator, an amplifier, or a mixer and not bother himself with such complexity.

Frankly, today's receiver still uses the same principles developed back in the dark ages when the ARRL vehemently objected to the use of the "new" superheterodyne. The block diagram shows a typical scheme of the up-to-date receiver. At first glance, it looks a little frightening, but it really isn't that bad if you just take one part at a time.

To most homebrew artists, there's nothing really too mysterious about a crystal-controlled converter, in which a whole band is converted to a range that can be covered more readily by whatever receiver may be available. Looking at the first part of the block diagram of the receiver, we

find a broadband rf amplifier and mixer. If we ignore the fact that the local signal is coming from a synthesizer, and imagine it to be the output of a crystal oscillator, we have a block diagram of a typical crystal-controlled converter.

Taking a look now at the remainder of the receiver, except for the synthesizer, we have a dual-conversion receiver covering 9.0 to 9.5 MHz. The purpose of dual conversion is to combine the advantages of a high i-f with those of a low i-f. When a high i-f is used, image signal frequencies are so far removed from the desired signal frequency they are eliminated altogether. The disadvantage of a high i-f is that high selectivity is much more difficult to achieve. Bandwidth is a direct function of Q and frequency. If the Q of a tuned circuit is held constant while its frequency is varied, the bandwidth will be narrowest at the lowest frequency. For a really selective receiver, a low i-f is required. However, when the i-f is low, it is harder to reject image signals because they are closer to the desired signal.

The answer is two conversions. The first uses a high i-f, which gets rid of images. The first i-f passes through a tuned stage, then it enters a second mixer, where the heterodyne process is repeated all over again. In this case, when the incoming signal is of one frequency, and one frequency only, the local oscillator can be crystal controlled. The new i-f is only 240 kHz. (Some commercially built receivers went as low as 50 kHz.) At a frequency as low as this, a couple of tuned stages can give a bandwidth as low as 3 kHz (or less). Commercial receivers sometimes have the final i-f stages deliberately loaded to open

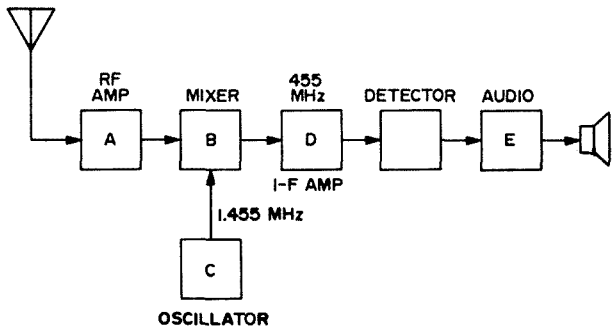


Fig. 1. A basic superheterodyne receiver block diagram.

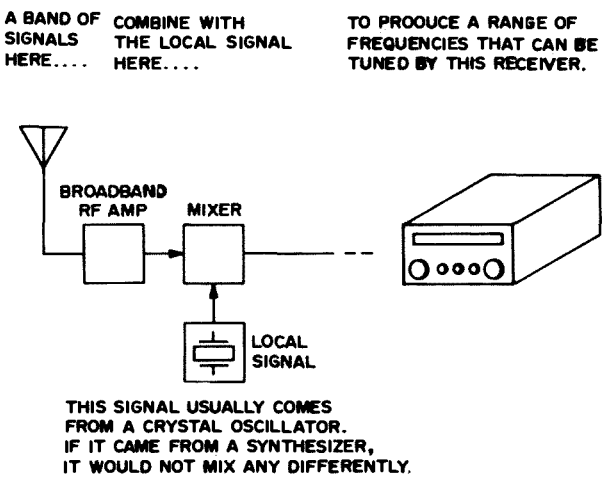


Fig. 2. Basic theory of a crystal-controlled converter. Nothing new to the ham — especially the mobile enthusiast.

up the bandwidth, then they insert a crystal or mechanical filter to give the bandwidth the desired shape.

Having explained the purpose and theory of double conversion, let us turn our attention back to the mixers. Nowadays, the best mixers are exactly the same thing as the balanced modulators used in SSB work. In fact, they *are* modulators and always have been. The advantage of using an SSB modulator is that it gets rid of the two original frequencies entirely, hence a quieter, more efficient mixer. Many of the commercial receivers that use vacuum tubes (and quite a few do) use the type 7360 beam-switching pentode as a mixer.

Some of the better solid-state receivers use a diode-bridge-balanced modulator for their mixers. The input transformer for such a mixer is very critical, however, if the best results are to be realized, so the ham who isn't too proud to use tubes will find the 7360 can't be outdone.

While we're on the subject of mixers and balanced modulators, it is a good time to mention a related circuit, the product detector. A product detector is exactly the same as a mixer or frequency converter circuit, except that the output is audio, rather than rf. The principle is the same as has long been used wherever a bfo signal is mixed with an incoming CW or SSB signal to produce audio. The difference is that the product detector gives no output at all unless both the i-f and the local signal are present. Here again, balanced modulator

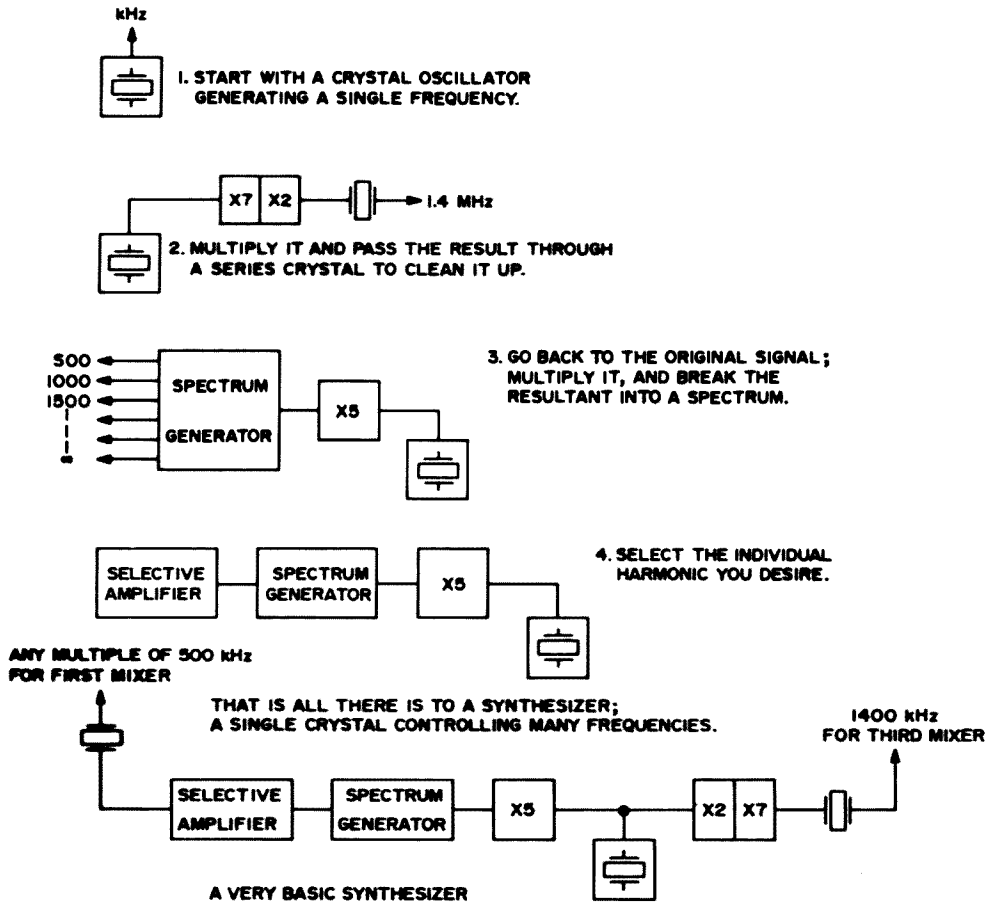


Fig. 3. A very basic synthesizer.

circuits are superior to pentagrid or triode mixers and their solid-state counterparts, since only audio is present in the output. (A pentagrid mixer product detector would have the two rf carriers present in the output, which could produce a little distortion or noise.)

Going back to the mixers, in the original superheterodyne circuit, the local signal came from a vfo. In dual-conversion receivers, a crystal oscillator is used. In the more sophisticated receiver, they use a synthesizer.

A synthesizer is a device that produces a signal at a frequency different from the input signal or signals. A frequency doubler is a simple form of a synthesizer; a mixer is another. Modern receivers use a synthesizer to produce the several frequencies required for the various conversions involved, all being produced from the output of a single crystal oscillator. That way, if the crystal should drift slightly, all conversion frequencies in the receiver would drift at the same time, and by the same percentage. The receiver, then, would continue to hold its calibration. The receiver discussed in this article uses a relatively simple synthesizer. A 100 kHz crystal is multiplied up to 1400 kHz in a basic frequency multiplier.

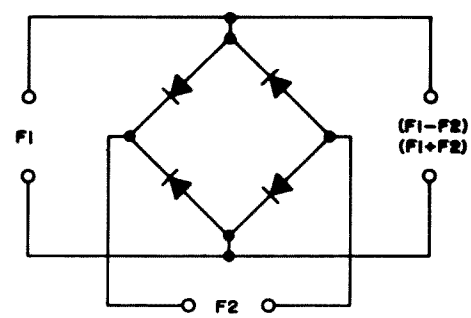


Fig. 4. A diode-bridge-balanced modulator used as a mixer.

The 1400 kHz signal passes through a series crystal and a tuned amplifier after which it is injected into the mixer for the final conversion. The original 100 kHz is also multiplied to 500 kHz and fed into a spectrum generator (the fancy name for a crystal calibrator). The spectrum, which consists of all multiples of 500 kHz, feeds into a selector, which isolates the desired

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multiple of 500 kHz, passes it through a crystal filter, amplifies it, and uses it as the local signal for the crystal-controlled converter (the first conversion).

By using exact multiples of 500 kHz for the first conversion, the receiver can select any frequency range 0.5 MHz wide, and convert to the range of the tunable portion 9.0 to 9.5 MHz. Since the tunable portion always tunes over the same frequencies, the receiver has the same bandspread regardless of the band of incoming frequencies.

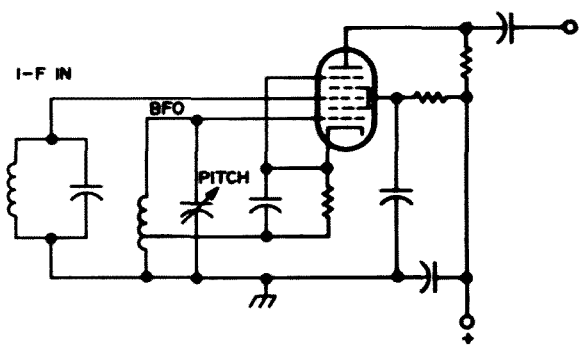


Fig. 5. A mixer circuit with audio output is a product detector.

(Some fancy mechanical manipulation by National engineers provided a dial that always have a 1 kHz per division calibration. The famous HRO 500 uses a spectrum conversion scheme very similar to the one I've described.)

Suddenly, now, the whole puzzle seems to fall together. Incoming signals are mixed with selected frequencies to convert them to the range of 9.0 to 9.5 MHz. This range is then tuned by a dual-conversion, 9.0 to 9.5 MHz receiver. The first and the third conversion come from the same 100 kHz crystal, while a stable vfo tunes the second conversion. Image rejection is achieved in the second conversion, which uses the 1640 kHz i-f, and selectivity is obtained in the final 240 kHz i-f. The receiver is a complex conglomeration of mixers, amplifiers, oscillators, doublers, and spectrum generator, but each part is, in itself, basic.

Several years ago, when financial adversity deprived me of a station receiver, and prevented my buying another, I decided to build one. Being employed, at the time, by National, I was immediately deluged with suggestions and the monster I have just described evolved. I chose to build it using tubes, rather than solid-state, simply because tubes are easier to scrounge. As time passed, my interest waned. Over the past couple of years, it has spent much more time on the shelf than on the bench.

Better times have come, now, and my interest in ham radio has gradually revived. I could easily go out and buy a receiver to get back on the air, but there is something about this project that bears a certain fascination. Perhaps I am a throwback, enslaved by my own stubborn pride. All I know is that I feel I must earn my place in the airwaves by producing that which gets me there. At any rate, come what may, I have completed my receiver, long ago humorously nicknamed the HRO .007 by a wisecracking National engineer and, so far, it works. With just the front end to go, I am determined that, by the time this article sees printer's ink, I'll be on the air once more, and I'll be one of the few hams of today who can truthfully say, "I made it myself."

. . .W2FEZ■

John Schultz, W2EEY/DL

SIMULTANEOUS MULTI-BAND TRANSMISSIONS

Simultaneous transmission on two or more bands has various technical advantages, and is allowed by the FCC under certain conditions. This article illustrates primarily simple combiner networks which will allow simultaneously the operation of two transmitters on different bands into one multiband antenna without transmitter interaction.

Simultaneous transmission of the same modulated signal on two or more amateur bands is permitted by the FCC under certain circumstances as discussed later. Such simultaneous transmission has various advantages in increasing the dependability of reception if a separate receiver is used on at least two of the transmitted frequencies and also an advantage in permitting reception on different single band receivers. The simultaneous transmission technique is often employed by shortwave broadcasters, commercial traffic stations, etc. Usually a separate transmitter and antenna is used for each band. However, for the amateur situation where multiband antennas are available and space for antennas restricted, it would be advantageous to have two transmitters operating on different bands coupled to one antenna for simultaneous operation. The networks which permit the use of transmitters in this manner are called "combiners." Many elaborate forms of such networks have been developed for commercial applications. However, the purpose of this article is to present various simple forms of "combiners" which can be quickly constructed for use with medium power transmitters, particularly where operation on two bands having a harmonic relationship is involved.

Legality of Simultaneous Transmission

It would be nice if one had the equipment available to send out something like a directional CQ or DX CQ simultaneously on several bands in order to have a better chance of making the desired contact. However, such operation, unless some emergency situation is involved, would be considered a waste of spectrum space by the FCC and therefore illegal. The sending of code practice transmissions simultaneously by stations such as W1AW is considered legal because of the large numbers of amateurs served thereby.

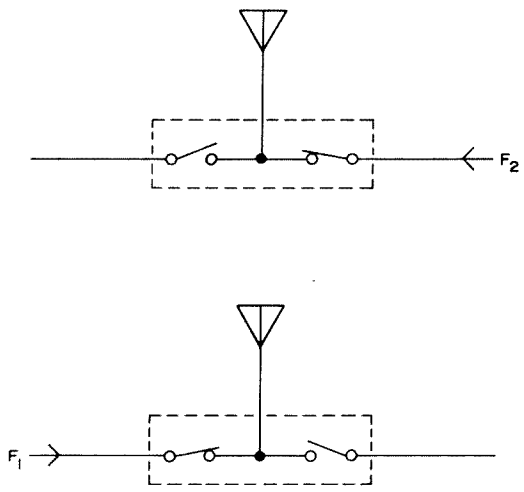


Fig. 1. Representation of the functions of a combiner unit (dotted lines) when either transmitting frequency alone is considered.

Various emergency and other communications that fall under Section 97.91 (b) and (d) of the Commission's Rules can be carried out using simultaneous multiband transmission. There is no hard and fast list of situations that one can specifically cite where such transmission is allowed. However, there are certainly many emergency communications situations and situations that serve the general amateur radio service where the technical advantages of simultaneous transmission is justified to the extent that it will be allowed by the FCC. No special license or permission is required for such operation as long as the basic operator's license is valid for operation on each frequency band used.

Combiner Operation

Fig. 1 illustrates the basic functions which a combiner network must perform. The antenna is assumed to be resonant at frequencies F1 and F2 (either broadband resonance or a trap-type antenna resonant at two different frequencies). When frequency F1 is considered as the output of one transmitter, the combiner network must act so the transmission line from the antenna is directly connected to the transmitter, but the transmission line to the other transmitter appears disconnected. When frequency F2 is considered, the transmission line from the F1 frequency transmitter must appear disconnected from the antenna.

There are a number of practical circuits that can be devised to implement the functions illustrated in **Fig. 1**. **Fig. 2** shows two simple basic approaches – a tuned circuit (A) and a transmission line stub switching arrangement (B). In **Fig. 2A**, F1 is assumed to be lower in frequency than F2. The frequencies in this case must not necessarily be harmonically related. C1 and L1 are chosen so series resonance is produced at F1, thus connecting the F1 transmitter directly to the antenna. C1A and L1 form a parallel resonant circuit at F2, so the F2 frequency cannot flow back into the F1 transmitter. On the other "side" of the combiner, C2 and L2 are series resonant at F2, thus directly connecting the F2 transmitter to the antenna. Since F2 is higher than F1, the L2, C2 circuit will provide a capacitive reactance at F1. This capacitive reactance is utilized together with coil L2A to form a parallel resonant circuit at F1. Thus, the F1 frequency cannot be coupled into the F2

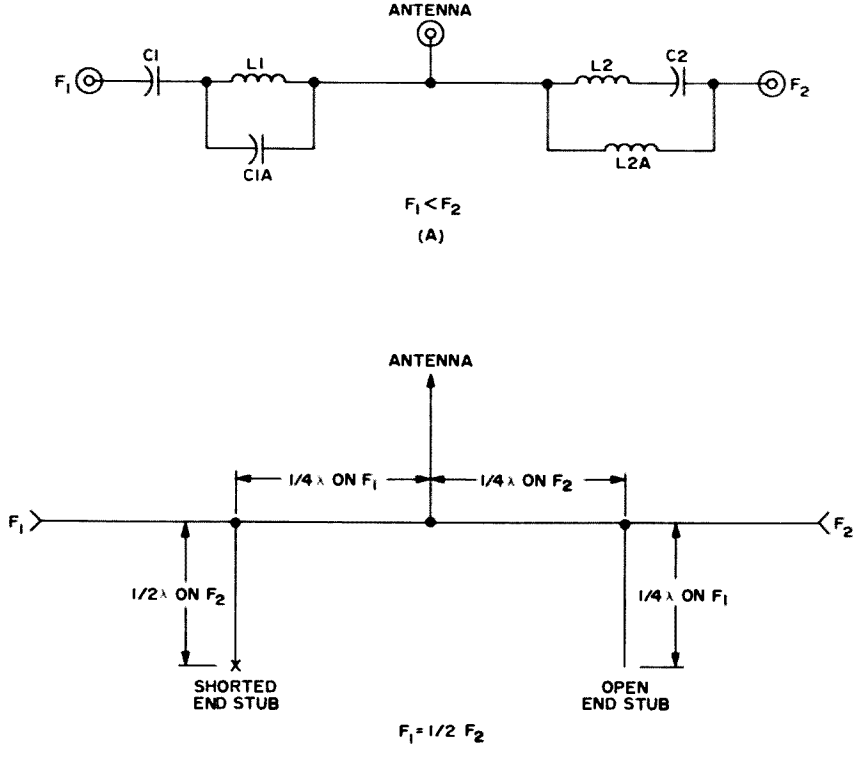


Fig. 2. Basic combiner forms discussed in text. Tuned circuit type (A) and stub type (B).

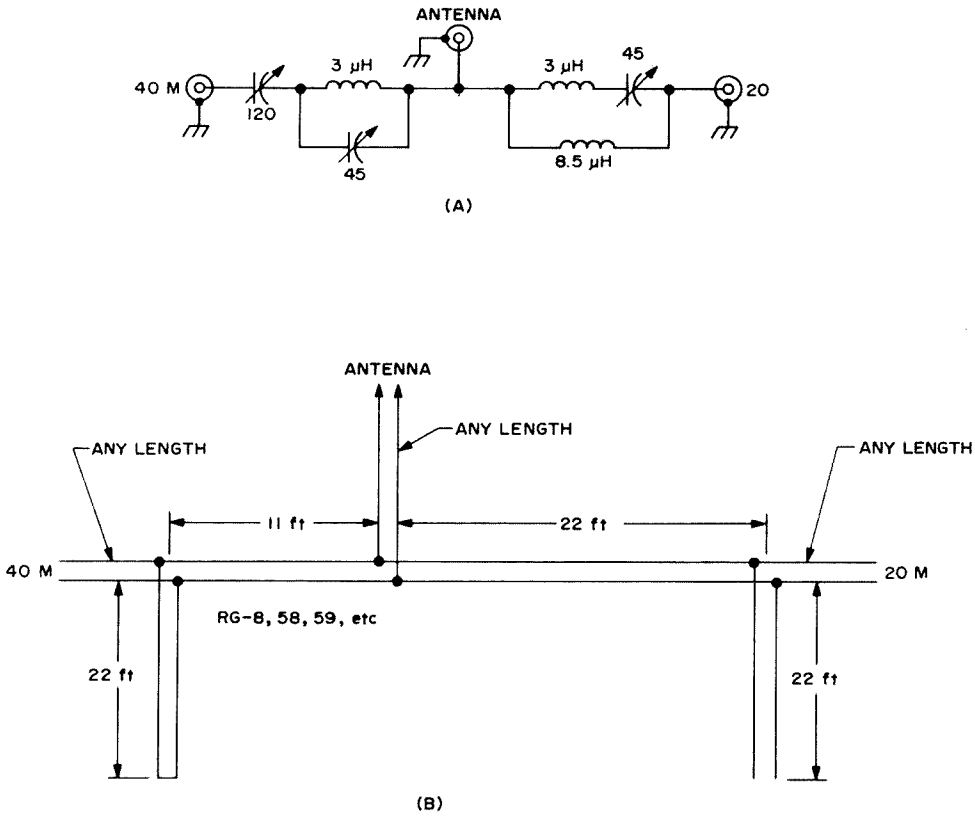


Fig. 3. Practical values for 40/20 meter combiner units. Similar combiners may be constructed for other combinations of amateur bands.

transmitter. The practical construction of such a network requires only the calculation of the component values using standard resonant circuit formulas or can even be done using a LC reactance chart. As high a Q as possible in the tuned circuits is desirable both to reduce losses and to provide maximum coupling isolation between transmitters.

The simple transmission line combiner shown in **Fig. 3(B)** requires that frequency F be one half of that of F2. Normal transmission line (coaxial or balanced type) can be used for the entire construction. The operation can be visualized by first noting that both F1 and F2 transmitters are directly connected to the antenna. However, they are not interconnected to each other. On the F2 "side" of the combiner, the open end stub is ¼λ long at F1. Thus at F1, it reflects a short where it is connected to the transmission line. The length of line between this point and the antenna is also chosen to be ¼λ long at F1. Thus, the short is further reflected at F1 to be an open circuit at the point where the F2 transmitter line meets the antenna. Consequently, F1 cannot couple to the F2 transmitter line. The open end stub on the F2 "side" does not interfere with the F2 frequency because at F2 it is ½λ long and reflects an open circuit across the transmission line. At F2, the transmission line doesn't "know" the stub is there.

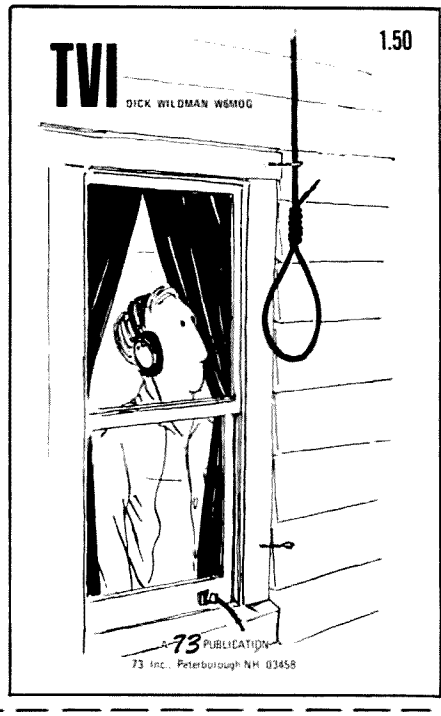
A very similar situation exists on the F1 "side" of the combiner. The shorted end stub being ½λ long at F2 reflects a short at the point where it joins the transmission line. From this point to the antenna, the line is chosen to be ¼λ long at F2. Thus, the short is further reflected to be an open circuit at the antenna terminals for F2. F2 energy cannot enter the F1 transmission line. The shorted end stub is ¼λ long at F1, and thus reflects an open circuit across the transmission line at F1. The combiner can be readily constructed from standard transmission line stock by taking into account the velocity factor of the line used

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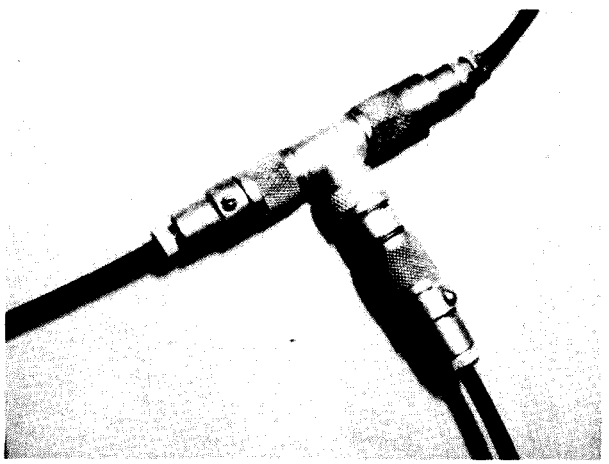
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to determine the correct physical line lengths.

Practical Examples

Fig. 3 shows two practical examples of both a tuned circuit and stub type combiner which can be used to couple 20 and 40 meter transmitters to a single antenna for simultaneous transmission. The tuned circuit combiner of **Fig. 3 (A)** is shown as it might be used in a coaxial cable transmission line system of any impedance. The transmission line from each transmitter must, of course, correctly match the antenna line impedance. The combiner serves only as a coupling and isolation network, but not as an impedance matching device. The coils should have as high a Q as possible. For low power transmitters up to a few hundred watts, standard B & W or Air Dux coil stock can be used; but for higher powers, coils made from copper tubing should be used. The coils should also be isolated from each other by mounting them at right angles to each other or using shields between them. With each connector dummy loaded by a small resistor corresponding to the impedance of the transmission line used, a grid-dip meter coupled to the 3 μH coil on the 20 meter "side" of the combiner, the 45 pF capacitor on that "side" is adjusted for circuit resonance on 20 meters. With the grid-dip meter loosely coupled to the 8.5 μH coil, that coil is trimmed for resonance on 40 meters. On the 40 meter "side" of the combiner, the grid-dip meter is loosely coupled to the 3 μH coil. The 120 pF capacitor is adjusted for resonance at the 40 meter operating frequency. The 45 pF capacitor is adjusted for resonance on 20 meters.

The stub type combiner of **Fig. 3 (B)** usually needs no adjustment if the stub lengths are carefully cut to length. The physical lengths shown, for instance, are based upon a velocity factor for the transmission line of .66, and would be correct for such cables as RG-8, RG-58 RG-59, etc. Standard coaxial cable "hardware" such as shown in the photograph can be used to make all the necessary cable interconnections or the cables can be carefully spliced together.



Standard "UHF" type coaxial hardware may be used to make all the necessary interconnections for a stub-type combiner. Shown are PL259 plugs used with a M-358T adapter and a PL258 female adapter in the middle leg.

The schemes shown can be expanded for more than dual-band operation, but extra tuned circuits and stubs would be necessary, resulting in rather complicated networks. If you did want to pursue this approach, it probably would be better to combine two transmitters operating on the lower frequency bands and two transmitters operating on the higher frequency bands in the manner shown. Then the outputs could be combined using a high and low pass filter circuit between transmitter groups for isolation.

No combiner network provides absolutely complete isolation between transmitters. When tuning up the transmitters, each transmitter should be tuned separately for proper loading with the other transmitter inactive. When both transmitters are tried, the slight interaction produced may require some transmitter retuning, but the amount necessary should be minor.

Summary

Used properly and legally for the right purposes, simultaneous multiband transmission can be very useful to better coordinate emergency nets operating on different bands, placing emergency traffic, etc. The proper use of the combiner circuits shown will permit the more useful utilization of the station equipment available which often greatly exceeds the antenna facilities which are available.

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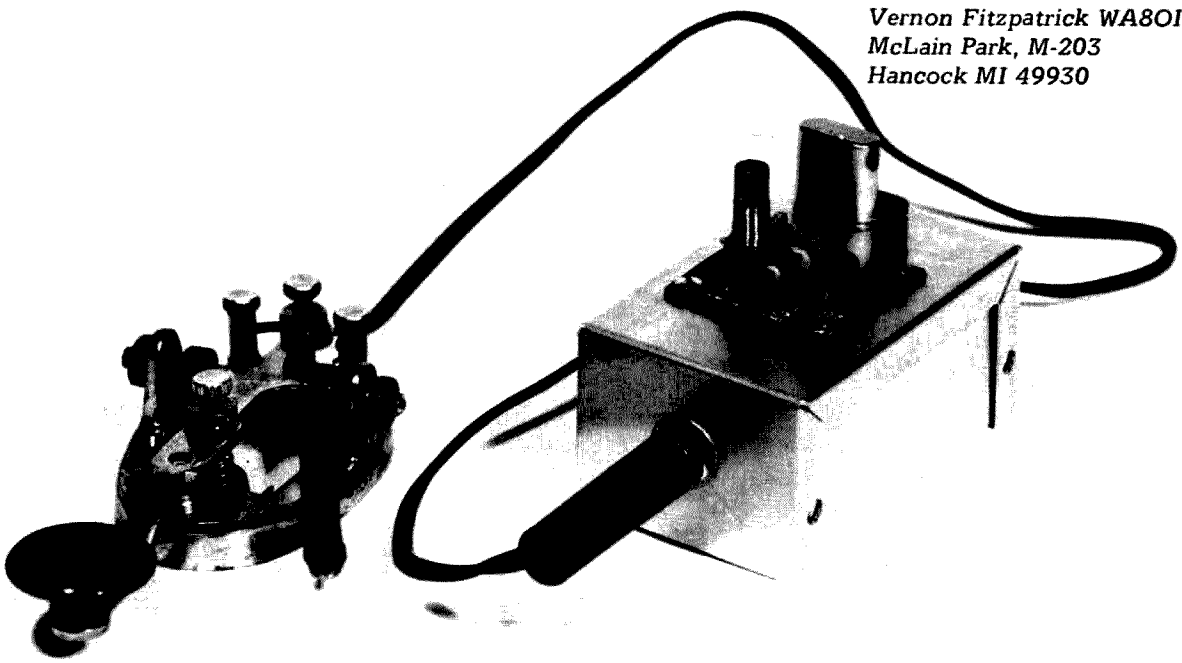
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The pre-Novice "transmitter" with key.

A PRE-NOVICE TRANSMITTER

For most aspiring hams code practice is the most difficult part of getting the ticket. Copying practice can be quite diversified. There are the records or tapes for learning the characters, then the practice can be supplemented by listening to W1AW or Novices. Sending is generally limited to keying an audio code practice oscillator.

The following idea is not original or unique as the Signal Corps was using it as part of its radio operator training in 1948, when I took the course. As a diversion, and to add interest to our code practice, they had a receiver for two students and a Meissner signal shifter (a variable frequency oscillator) a few feet away. We would close the key and locate the signal on the receiver; then send to each other. We were transmitting less than 10 ft but it was our first time "on the air." It was quite a thrill.

Here is a simple building project and you will have a transmitter of across-the-room capability. The oscillator is an International Crystal Co. OX-LO kit*. Assemble the kit following the instructions for 3000–6000 kHz, as this will permit using 80 meter crystals. The oscillator can be mounted on a piece of wood, but a more professional job can be done by mounting it on a minibox. The OX circuit board has a crystal socket for HC-6/U crystals mounted on it. I mounted a Cinch-Jones 2KM crystal socket on the minibox, then connected it in parallel with the circuit board crystal socket. This arrangement permits using either HC-6/U or FT-243 crystals. All my CW transmitters have a standard ¼ in. phone jack for the key, so I mounted this type of jack on the front of the minibox. Whatever type jack you use be sure it is the open-circuit type as there is no power switch on the oscillator. The key turns it on and off. The battery is made by connecting four size N-cells in series, then taping them in a square. Be sure to tape the top and bottom so the battery can't be

shorted. Connect a 3 in. red wire to the positive terminal and a 5 in. black wire to the negative terminal. If you use a larger minibox, a plastic or metal holder for four penlite cells can be used.

Final Assembly

Make all holes in the minibox before mounting the oscillator. Mount the oscillator board. The mounting screws supplied with the kit are quite long. 4-40 x ¼ screws will be neater. Mount the 2KM crystal socket. Mount the key jack. Clamp the battery in place. Using two pieces of wire 5/8 in., wire the 2KM crystal socket in parallel with the crystal socket on the oscillator board. Solder the red battery lead to the 6V terminal on the copper foil side of the printed circuit board. Solder the black battery lead to the insulated terminal on the key jack. The negative circuit is completed through the key and jack to the minibox, then to the copper foil on the PC board. If you use a painted minibox, be sure to scrape the paint away around the four PC board mounting holes so there will be a good electrical contact from the copper foil to the minibox. This completes the wiring of the "transmitter." Any 80 meter crystal can be used, but it is best to use a Novice band crystal as this will help you get used to this band on your receiver. Do not connect any type of antenna to the oscillator as it is capable of transmitting a signal several miles with an antenna.

If your key is not wired, two-conductor speaker wire is good, as it is light and flexible and one wire is marked. Connect the marked wire (it may have a tracer stripe on the insulation or one wire may be tinned and the other copper) to the key frame terminal. Connect the other wire to the insulated key terminal. Connect the marked wire to the phone jack outside or barrel terminal. Connect the unmarked wire to the phone jack tip terminal. If your key has a shorting bar be sure it is open.

Now is a good time to adjust the key. Adjust the pivot bearings so the key points are aligned; the bearings should be adjusted so there is no play or bind. Adjust the point gap so a piece of postal card will just pass through. The tension adjustment is for

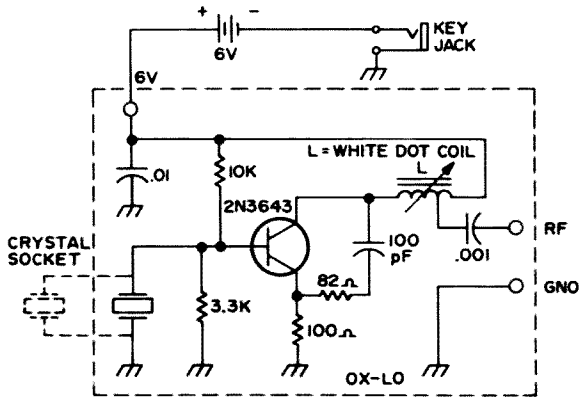


Fig. 1. OX-LO kit has all parts shown inside dotted line. OX-LO kit ($2.95) available from International Crystal Manufacturing Co., Inc., 10 North Lee, Oklahoma City OK 73102.

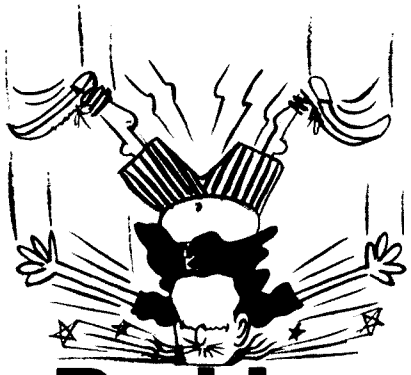
the individual fist. It should not be weak enough so your hand relaxed on the key will close it. Lightly grip the edge of the key knob with the thumb and large finger. Rest the index finger on the knob. Raise and lower your wrist to send. You cannot send with your fingers, as they will tire in a few minutes.

Connect 3–4 ft of wire to your receiver antenna terminal and turn it on. When the receiver is warmed up, close the transmitter key and tune the signal on your receiver. You are now ready for some real code practice. The short antenna on your receiver may give you some background QRM. This is good, as you will have it when you are operating as a Novice.

If you are practicing with a friend and each of you has a transmitter, use crystals of the same frequency so you don't have to keep retuning the receiver. If you have only one transmitter, connect the keys in parallel. Connect a two-conductor wire from the two terminals on one key to the two terminals on the other key.

I think you will enjoy this method of code practice. It is as real as you can get without a license. You will find the little transmitter convenient for additional practice after you get your license, too. You may want to add the International Crystal PAX-1 transistor rf power amplifier module and have a QRP transmitter for on-the-air use.

. . .WA8OIK■



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Pittsburgh PA 15236

The Problem of Inversions

The designation of any SSB signal as either "upper" or "lower" is simply an indication of the *position* it holds, frequency-wise, with respect to its reference frequency, which is that which the carrier would occupy if it weren't suppressed. This position, due to the nature of sidebands themselves, determines the characteristics which an individual sideband will possess.

The term "inversion," however, denotes a *change* of the sideband signal from its original to the *opposite* position, which change necessarily results in the signal's acquiring opposite characteristics as well. Accordingly, where no such change in the sideband signal has taken place, the signal, whether it be upper or lower sideband, cannot properly be considered as representing an inversion.

To get along, then, into this problem of inversions, let's go directly to the area where this problem arises: the mixer stage of our SSB rig. While the intended function of this stage is simply to convert the *frequency* of either the USB or LSB signal generated in an earlier stage to a desired output frequency, this stage sometimes does a bit more! The "more" bit is the alteration or change of position and characteristics of the SSB signal – an LSB signal becomes USB, or a USB signal becomes LSB.

Since an inversion occurs in some cases, and in others it doesn't, the question naturally arises as to whether the occurrence or nonoccurrence in a given situation can be predicted reliably. It can.

Let's suppose that we're introducing to the mixer a 9 MHz USB signal and injection frequencies from the output of a 5.0 to 5.5 MHz vfo, from which mixture we obviously obtain output in the 20m band by utilizing the *sum* frequencies, and output in the 80/75-meter band by utilizing the *difference* frequencies. On either of these two bands, our output will be USB, the same as our input sideband signal, as no inversion will result when any sum frequency is utilized, and no inversion will result *in this situation* when any difference frequency is utilized. If, in this example, we used an LSB input signal instead, our output on either band would be LSB for the same reasons.

Before presenting an example of a situation in which an inversion *will* occur, however, it should be pointed out, even though it's pretty apparent that to obtain outputs in bands other than 20 and 80m, we will require injection frequencies additional to those supplied by the vfo alone. Premixed injection frequencies for this purpose can be obtained simply by employing an auxiliary oscillator along with our vfo.

Now, let's suppose we're interested in working, say, the 15m band using the same 9 MHz USB signal. Using a premixed range of injection frequencies from 12.0 to 12.5 MHz, we could obtain outputs from 21.0 to 21.5 MHz by using the sum frequencies, and our output would be USB, the same as our input sideband signal, since no inversion would take place. However, using a premixed range of injection frequencies from 30.0 to 30.5 MHz instead, outputs in the same range (21.0 to 21.5 MHz) could

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be obtained by using the difference frequencies, but here an inversion *would* take place and our output would be LSB. To obtain a USB output, using the 30.0 to 30.5 MHz injection frequencies, our 9 MHz input signal would have to be LSB.

We've offered two examples here involving utilization of *difference* frequencies, in one of which examples we've claimed that an inversion *will* take place, and in the other we've claimed that it *won't*. Since both examples involved difference frequencies, there must obviously be some difference in their differences. The difference in the difference frequencies, to keep things simple, could be labeled as *positive* and *negative* differences, with the appropriate label being established simply by subtracting the injection frequency from the input sideband signal frequency, but *never* the other way around!

In any case where the injection frequency is *lower* than the input sideband signal frequency (as when, to obtain 80m output, we mixed the output of a 5.0 MHz vfo with a 9 MHz sideband signal), a

Table I. Sideband Inversion Logic

GIVEN	Frequency A (USB) Frequency C (Inj Freq)	Frequency B (LSB) A or B
APPLICATION	Frequency A (USB) minus Freq C Mixer Output 1 (USB)	Frequency B (LSB) minus Freq C Mixer Output 2 (LSB)
GIVEN	Frequency D (Inj Freq)	A or B
APPLICATION	Frequency A (USB) minus Freq D Mixer Output 3 (LSB)	Frequency B (LSB) minus Freq D Mixer Output 4 (USB)

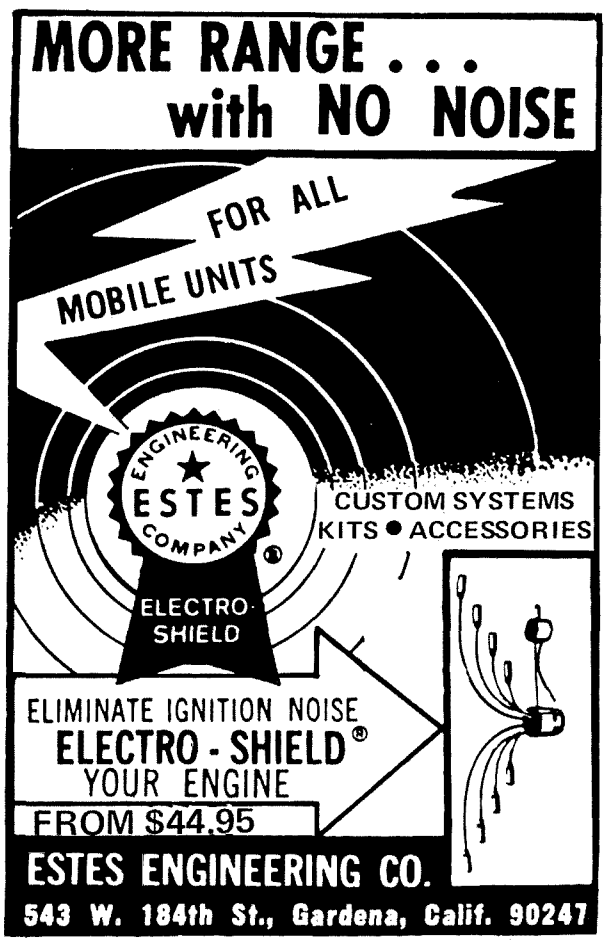
positive difference will result. Subtracting 5.0 from 9.0 gives a *positive* difference of 4.0. Likewise, in any case where the injection frequency is *higher* than the input sideband signal frequency, as was the case when, to obtain 15m output, we mixed frequencies from 30.0 to 30.5 MHz with our 9 MHz sideband signal, a *negative* difference will result. Subtracting 30.0 from 9.0 gives us −21, since we're subtracting larger figures from a smaller one, which differences are clearly *negative* differences.

Proof covering the claims made in this article as to when an inversion will occur and when it won't is available in two forms, either of which should suffice to dispel any doubts concerning the reliability of these claims. One involves the examination of an actual rig utilizing frequencies identical to those used in our examples, and the other involves recourse to "sideband inversion" logic.

The popular combination of a 9 MHz sideband signal and a 5 MHz vfo, which was used in our examples, along with an auxiliary oscillator, when needed, is utilized in the Hallicrafters HT-46 transmitter, which makes it one of a number which could serve to illustrate the occurrence or nonoccurrence of inversions in the manner claimed. On the band selector of the HT-46, we find the 80 and 20m bands marked in *red*, and all other bands marked in *white*. Encountering this situation cold, it would be natural to suppose that something happens on 80 and 20 that doesn't happen on any of the other bands. But, having already read the information offered earlier in this article, you will have guessed correctly that exactly the opposite is the case here. The red markings indicate the bands on which inversions do *not* occur, and the white markings indicate those bands on which they *do*, even though no mention of inversions, as such, is made anywhere in the operating manual on this rig. Output in the 20 and 80m bands is obtained by utilizing *sum* frequencies for 20, and *positive* differences for 80, in both of which situations we claimed that no inversion will result, which claim is supported by both of these bands being marked in red. Output in all of the other bands (40, 15, and 10) is obtained by utilizing *negative* differences, in which situations we claimed inversions will always occur, which claim is supported by the white markings for each band obtained in that manner.

Our alternative proof is in sideband inversion logic, as offered in Table 1. If frequency A represents the upper sideband of any pair of sidebands and frequency B the lower, then, by the definition of sidebands themselves, A must be higher than B. Frequency C in our chart represents any injection frequency lower than A or B, and frequency D represents any injection frequency higher than A or B. The substitution of any actual frequencies for the letters in the table will establish that, without exception, inversions will occur only with *negative* differences.

. . .K3WNX



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Glenroy, Victoria
3046
Australia

A MEDIUM FREQUENCY CONVERTER FOR HIGH FREQUENCY RECEIVERS

When today's "oldtimers" were learning the code in the '20s and '30s, they copied a lot of it on the "medium-frequency shipping band." Today's communication receivers seldom cover the broadcast band, let alone frequencies below 530 kHz. There are many interesting signals to be heard on 500 kHz; passenger liners, cargo ships, coastal stations, commercial traffic, ship position reports and weather bulletins. The MCW signals on these frequencies pack a distinctive punch; fellow ex-marine radio operators will know what I mean; and recently I decided to settle an urge to hear them again. Almost every ham I know has one or more old BC radio sets in his junkbox, and this seldom-used junk is just what you will need for this simple medium-frequency converter. Component values are not critical, and the unit gives excellent results.

My station receiver is a Drake 2B and tunes from 3.5 MHz to 4.1 MHz on its lowest frequency band. With this converter, I can tune from 400 kHz to 1000 kHz, using the 2B on 80m. I used a 3100 kHz crystal with a trimmer capacitor across the socket to adjust the crystal frequency to exactly 3100 kHz, and get accurate frequency readout from the 2B dial. Any similar crystal will do if you make suitable allowances; e.g., 3200 kHz will give a tuning range of 300 to 900 kHz. If you have a 3500 kHz crystal and are not interested in the lower part of the broadcast band, you can use that instead. In theory, this will give you a tuning range to 600 kHz. I tried a 3500 kHz crystal, and found that I could hear signals as low as 200 kHz, despite the fact that the converter input will only peak to just below 400 kHz with the component values given. From 200 to 400 kHz you will hear a variety of radio navigation beacons, and from 400 kHz upwards, you will tune the shipping band.

The tuning capacitor is an old two-section variable with both sections in parallel, and a 100 pF mica added to give a total capacity of about 1000 pF. If your junkbox offers you a three-gang type, by all means use it. The coil is a standard broadcast band antenna coil, from a set that used a wire antenna rather than a loop or ferrite rod. If in doubt as to which winding is which on the coil, the commonly used connections are shown on the circuits of Figs. 1 and 2. If you have an unmarked coil, you have an excellent chance of wiring it right first time if you measure the dc resistance of the windings with an ohmmeter; the tuned winding normally has the lower resistance of the two. As well as the coil and capacitor, the old radio that I stripped had a triode hexode converter tube (6K8). Having used

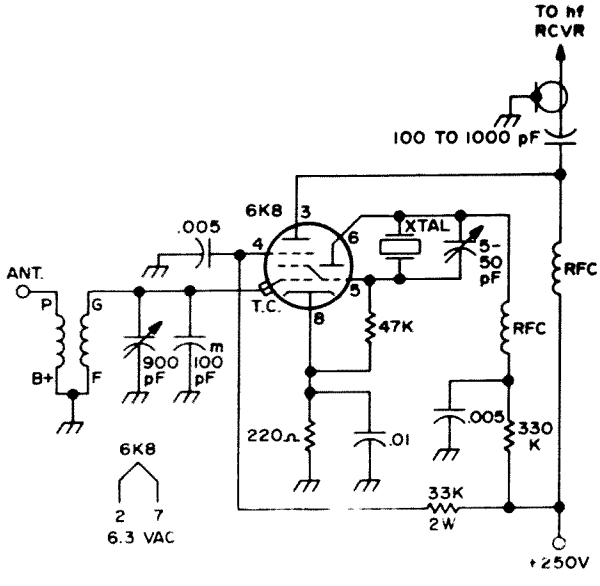


Fig. 1. A medium-frequency converter for high frequency receivers using a 6K8.

the coil and capacitor, I used the tube, too. Pentagrid tubes such as the 6SA7 and 6BE6 are not suitable for this circuit due to their internal construction; however, an excellent modern tube for this converter is the 6U8 triode pentode. Circuits for both tube types are given.

Use as low a voltage as possible on the oscillator section plate, consistent with reliable starting of the crystal. This minimizes spurious mixing and breakthrough of unwanted signals. If your B+ supply differs greatly from my 250V, it may be necessary to alter the values of the B+ line resistors, but they should be near enough for voltages from 220 to 280V. If you use a 6U8, you may have to experiment with the oscillator plate resistor to find just what value is best; I suggest you use a 500 kΩ pot at first, and adjust it to a setting that gives good results; then replace it with a fixed resistor of the same value. The bypass and coupling capacitors in both circuits are not critical in value; in Australia, a very convenient source of .005 μF disk ceramic capacitors is discarded starter units for fluorescent lights. Each starter contains a glass-enclosed switch and a bypass capacitor. The rf chokes can be any that you have on hand; if one is better than the other, use the best one in the mixer plate.

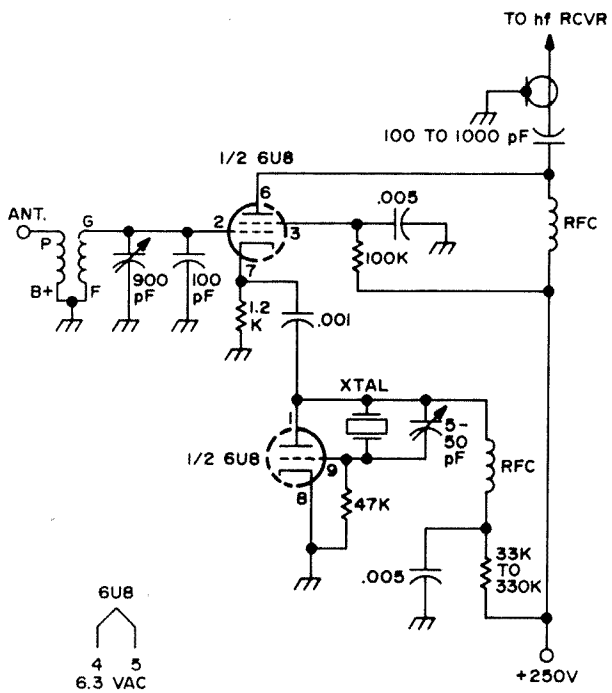


Fig. 2. Converter circuit built with 6U8.

The cable from the converter to the receiver antenna input should be coax of course; anything in the 50–75Ω range is ideal.

The power requirements could probably be met from most receivers, but I take my power from the lightly loaded supply that feeds my vfo. The converter was built on a small chassis of 9 by 3 by 2 in., which suits the space I had available on the radio desk.

In use, I select the required frequency on the Drake dial, peak the preselector tuning, and then peak the required medium-frequency signal with the converter tuning capacitor. My station antenna is only a 67 ft long, Windom-fed, inverted vee, 25 ft high at the center, but seems adequate for 500 kHz reception, as I have heard signals over 2000 miles away at night, and up to 500 miles by day.

The coastal radio stations call on 500 kHz, and use one working frequency, generally between 414 and 492 kHz, though one or two frequencies have been allocated between 514 and 520 kHz; the power is around 2 kW. Ships call on 500 kHz and have 410, 425, 448, 454, 468, 480, and 512 kHz for working frequencies. Most cargo ships run 500–900W, and passenger ships run up to 2 kW. All stations observe two "silent" periods each hour; two 3-minute periods beginning at 15 past and 45 minutes past the hour.

Hams who are boating enthusiasts will find the local coast stations' weather bulletins of interest, and with code speeds varying from 15 wpm to over 25 wpm, there is plenty of practice available. The quality of code varies, too; from the roughest imaginable, to the perfection of machine type Morse.

This converter can be used with any receiver that covers 3.5–4.1 MHz or higher; build it yourself and see how interesting the lower frequencies can be.

My grateful thanks are due Gil Moody (VK3ZR) for suggesting that the mixer plate load be an rf choke. Without this advice, I would certainly have used tuned output, and run into no end of trouble with tracking problems and receiver overload.

. . .VK3IQ■

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Upton on Severn
Worcester, England

EASY END FEED Z-MATCH

If we look for the quickest, easiest, cheapest way to put out a signal on any band from 80 to 10, we see that the answer is an end-fed wire. This has extremely variable characteristics in terms of radiation, depending on length, band, direction, etc. On any particular band it is generally about as good as a dipole, if similar in length to a dipole for that band. On lower frequencies it may be a quarter wavelength or less, while on higher frequencies it would be two half-waves, or more.

The beauty of the end-fed wire is that in practice it can be *any* length. This means it is strung between the two best available supports, with one end (adequately insulated) descending into the shack. It may be vertical, sloping, horizontal, or a mixture of these, and is probably longer than about 20 ft, though it is unlikely to be over about 125–150 ft unless you are lucky with space.

Its feed impedance will be a variable thing, according to frequency, length, and other factors. The usual transmitter or transceiver pi output tank is mostly intended to work into a load of about 50 to 75Ω. So inevitably, this and the end-fed wire will be incompatible on some bands.

Z Match

An impedance or Z-matching device between transmitter and end-fed wire corrects matters so that all but extremely short wires will load the transmitter. Figure 1 is a simple but practical circuit. L is a robust tapped coil, and the variable capacitor is about 150 pF, wide spaced for other than low power. This was found satisfactory for any wire from 10 to 150 ft. With shorter wires arcing occurred. The longer wires naturally radiate better.

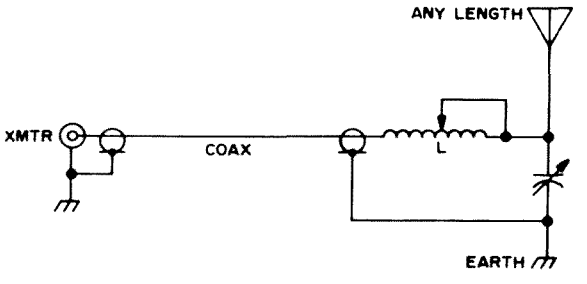


Fig. 1. Circuit of the type used.



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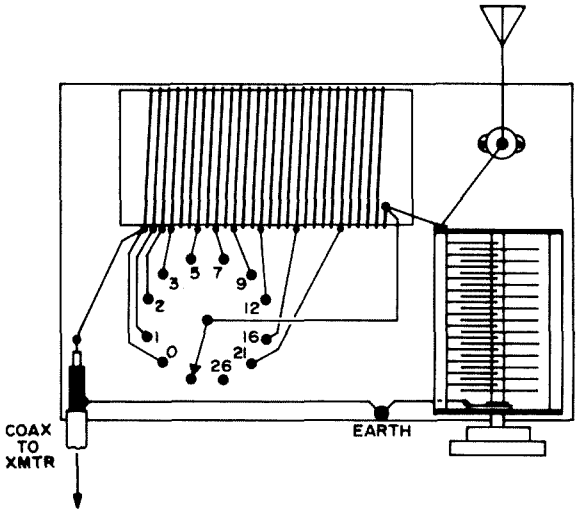


Fig. 2. Coil and other details.

This is a good opportunity to use a surplus inductor. The one actually used was wound for the job, however. It had 26 turns of 16-gage wire on a 2½ in. diameter ceramic form, the winding taking up 3½ in. Stout leads soldered on go to the tabs of a 12-way rotary switch (Fig. 2). The switch selects the following numbers of turns – 0 (coil shorted), 1, 2, 3, 5, 7, 9, 12, 16, 21, and 26 (whole coil).

An swr indicator may be put in the coax from the transmitter to Z match. A good earth ground is helpful. Remember, there may be considerable rf on the antenna connection.

The receiver or transceiver S-meter should give a guide to tuning. Begin with the capacitor at minimum, and no turns in circuit. Rotate the switch to bring up signals. When the best point is passed (too many turns) rotate the switch back one position, and peak the variable capacitor for best reception.

Adjustments are somewhat similar for transmitting. If the TX pi output capacitor is at about a setting which would work into around 50–75Ω, rotating the capacitor with the correct number of turns in circuit will show a point where the system draws power and can load the transmitter.

It was found that with quite long wires, the variable needs little or no adjustment over a fair section of a band. But with short wires, it has to be retuned with other than small changes in frequency.

. . .G3OGR■

Charles Gelsinger
4000 Camino Del Valle SW
Albuquerque NM 87105

Coat Hangar Antenna for 2 Meters *REVISITED*

When I saw the coat hanger antenna for 2 meters in the June 1969 73, I knew it was just what I was looking for, so I made one. It works nicely, but a few changes can make it even better. Since I use one 10 ft length of coax to connect transmitter to dummy load and transmitter to SWR, I wanted to use the same piece of coax on the antenna, but the original article had it soldered to the antenna directly. I made two modifications on this antenna, and now the coax is removable and it is now impossible to put an eye out with it. The grounding plane section of the antenna is dismantled and put together as follows:

1. Put two connectors, No. SO-239 back to back and solder them together with about ½ in. space between them (see diagram).
2. Cut a piece of plexiglas 3/8 in. thick, the size of the connectors (about 1 x 1), and cut out the area indicated on the drawing, then put it back together. Now you can screw the cable on and off when packing the antenna or storing it.

If you are afraid someone might get poked in the eye with the grounding section of the antenna, put four foam balls on the ends of the elements and paint them a bright color. I painted mine a bright orange and it really stands out. If you like your homebrew equipment to have your call letters, paint them in black on the colored balls. It really stands out. Good luck.

. . .Gelsinger■

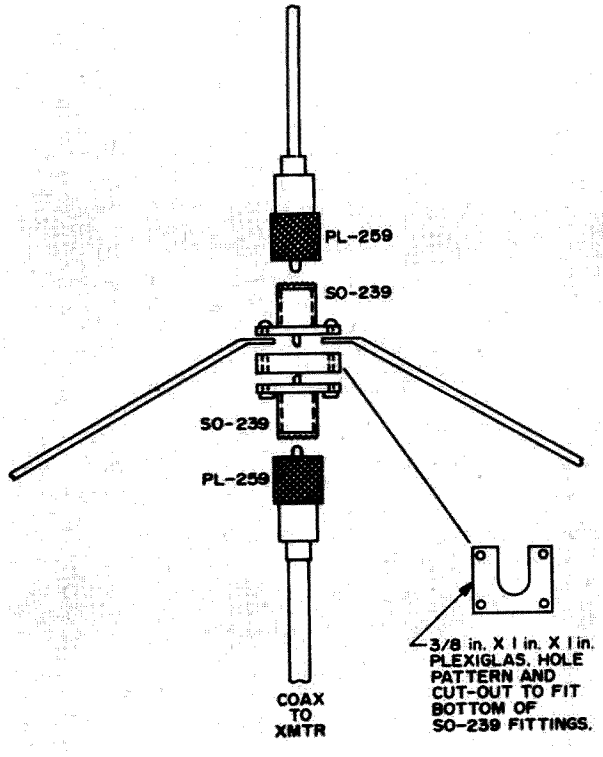
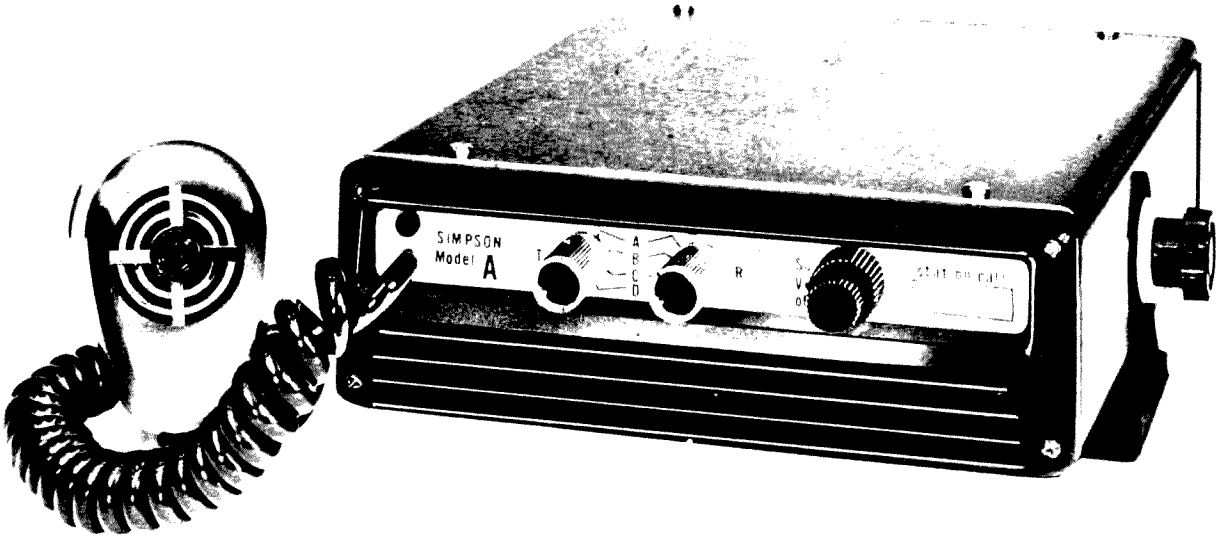


Fig. 1. Construction details of the improved groundplane.

73 Uses the Simpson Model A FM Transceiver

This is an amateur model of the very well known Simpson Model T marine transceiver, a four channel 150 MHz FM transceiver. The amateur who is looking for an American built unit of exceptional quality would do well to take a close look at the Model A.

Some of the features which make this transceiver so interesting to the FMer are its uncompromising construction, with nothing left out for economy. There are four transmit channels and four receive channels, and any may be paired with any other if you live in a mixed-up repeater area with machines on, say, 22-76, 22-82, 16-76, 25-76, 25-88, 28-88, 31-88, etc. Independent switching of the receive and transmit channels just may



be the way things are heading.

By tilting the oval loudspeaker back and building in a small air coupling section in front of the speaker, the Model A is capable of putting out a remarkably good sound. If your car has much more noise than a Rolls you may just need all the loudspeaker you can get to hear what is coming out of your receiver and you may find the usual 2 in. speaker a whisper in a windstorm when you rev up through the gears.

Separate boards are used for the receiver and transmitter functions, a fact which has alerted some of the more devious technicians in our midst to the possibilities of using the Model A for a repeater. All it takes are a few

wiring changes and a carrier operated relay to make the basic change. To my knowledge there are well over a dozen active repeaters around the country today using the Model A boards.

The transmitter puts out a minimum of 6 watts and uses the popular 6 MHz crystals (the same as the Regency transceivers). That power level is quite adequate for most repeater operation and represents a good compromise for your car battery longevity. You can always put in an external booster amplifier for boondocks work.

The receiver has a ceramic filter with 6 dB skirts at 13 kHz and 60 dB at 36 kHz, which means that a strong signal on 91 will not wipe out both 88 and 94 for you as it will in some other popular receivers. One good strong 91 machine can raise Ned for a hundred miles on three channels unless everyone has good selecting receivers. Sure, you can always buy a $15 filter and put it in yourself, but that means drilling holes and work which could be avoided if you chose a receiver with narrower bandwidth.

The oscillators all use diodes for switching, which means that you can actually switch channels from any distance you wish. This system is ideal for use with remote base installations where you might have the transceiver up on the top of a mountain and remotely operated by 450 MHz link or phone wires. You may not be able to live on top of a mountain or a tall building, but you might be able to stick a remote rig up there, which is the next best thing.

The oscillators are padded enough so you can buy inexpensive low tolerance crystals and zero them in. The pads are right out there where you can tune them too, rather than requiring a deformed midget with a lot of patience to get your crystals on channel.

The Model A is in a flat pack that will fit under the dash of most cars and still leave plenty of leg room. The box is made of extruded aluminum side rails with vinyl covered aluminum top and bottom covers and a front panel of injection-molded Cycolac. The circuit boards are glass expoxy and the parts are machine-wave soldered to them. In all, it is an extremely professional and commercial quality job of construction.

It also works.

...W2NSD/1

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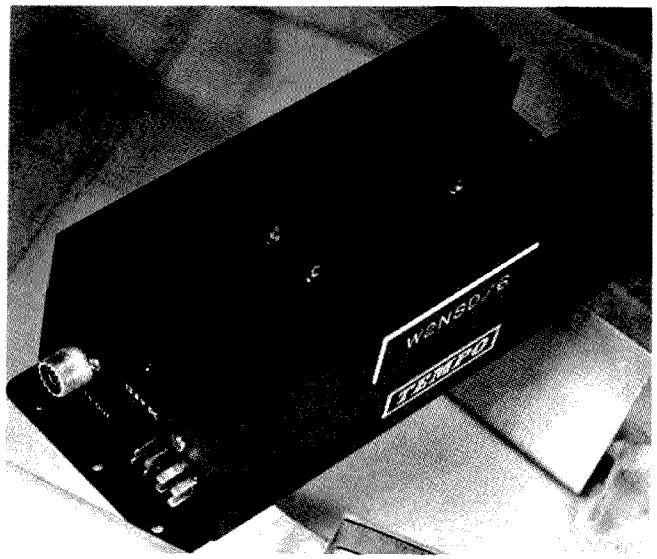
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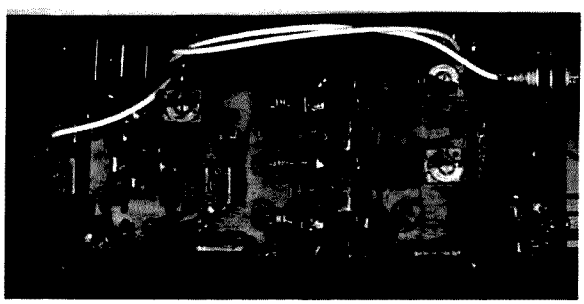
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73 Reviews

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While the ten watt output of most of the FM transceivers is quite adequate in the primary coverage area of repeaters, what amateur has not fretted when he was far enough out to copy the repeater solid, but could not trigger it? A hundred watt amplifier will give you quite a few more miles of good solid repeater usage, you may be sure.

But fellows, be fair, put in a switch to cut out the amplifier when you are close enough in so it isn't needed. No one is going to love you if your signal comes crashing in on top of all the other mobiles. Use these power amplifiers as a force for good, not as a means for getting on every shoot list within repeater range.

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Are these amplifiers difficult to install? No. Being small, 3" x 4" x 8½" for the 100 watt model, they will mount just about anywhere. My own preference is on the firewall under the front hood where the battery cable can be relatively short and deliver the 13.8 volts in good shape to the unit. A coax cable from the amplifier runs through the wall to the back of the transceiver, while the antenna connects to the other end of the amplifier.

When you turn on your transmitter a bit of the rf is rectified as it enters the amplifier and this actuates a send-receive relay, switching the antenna to the output of the amplifier. A 2N2222 transistor is used for the switching function, and TRW PT-8710s are used for the amplifier, with one as a driver and three in parallel in the final. As soon as the ten watts of rf stops coming through the hose from the transceiver the relay reconnects the antenna to the transceiver, cutting the amplifier out of the circuit.

If you are having trouble getting into a repeater you might consider going the power amplifier route.

In Action!

Using the Tempo 100 watt amplifier I have yet to find one repeater that I can hear well that I can't get into. With the amplifier off, my signals are frequently either marginal or else just don't make it at all when I get on the other side of a mountain, even though I can hear the repeater enough to copy it.

If you can get into every repeater you can hear, then you have nothing to gain from adding an amplifier. If your signals fade out before the repeater, perhaps this is your answer as it was mine.

...W2NSD/1

John J. Schultz W2EEY
1829 Cornelia St.
Brooklyn NY 11227

OPTIMAL VERTICAL ANTENNA LOADING TECHNIQUES

The author discusses the various techniques used to load vertical antennas. From the viewpoint of reasonable performance, ease of construction and bandswitching, a combination of top and base loading is favored. The construction of a pratical antenna is illustrated.

Many amateurs are faced with antenna placement situations which do not allow the erection of full-sized antennas. A loaded type of vertical antenna is often the only antenna possibility. Often, even a trap-type vertical cannot be used on the lower frequency bands because of the size of such an antenna and its support requirements. The only choice then is to use as long a vertical antenna as possible with as much loading inductance as necessary to resonate the antenna on a desired band. The physical length of such an antenna may be 1/6 or less of the electrical length it represents through inductive loading.

The subject of how to produce efficient, extremely short-loaded antennas has been the subject of numerous studies by commercial and military organizations. The purpose of this discussion is not to delve into the more advanced techniques which have been developed since such techniques often require special construction and special equipment for a relatively small gain in antenna efficiency. This approach may be necessary in some situations where the capacity of the power supply for a portable transmitter is limited and the only possibility to improve the radiated signal is through increased antenna efficiency. In the amateur case, and particularly for the newcomer who starts with a low-power transmitter, it is often easier and more economical to first try increasing the transmitter output level (via an inexpensive linear amplifier, for instance) rather than getting involved with complicated antenna construction projects. Therefore we will discuss only the simple forms of antenna loading which have been well proved and which are easy to build. The material is particularly oriented toward the newcomer who would like to construct a simple loaded type of vertical antenna that will give reasonable results on one or more high-frequency bands.

Loading Variations

A full-length quarter-wave antenna will have the current distribution shown in Fig. 1A. If the physical length of the antenna is made shorter than the required electrical length, a loading inductor can be used to establish the correct electrical length. When this is done, the current distribution may appear different than in Fig. 1A, depending upon where the loading inductor is placed. If the loading inductor could be distributed over the entire length available for the antenna (helical loading) the current distribution would look the same (Fig. 1B). Placing the loading inductor either at the extreme top or bottom of the antenna will

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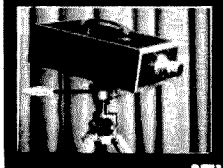
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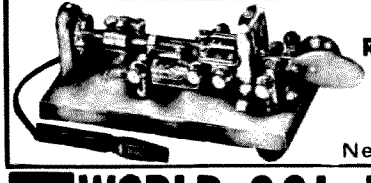
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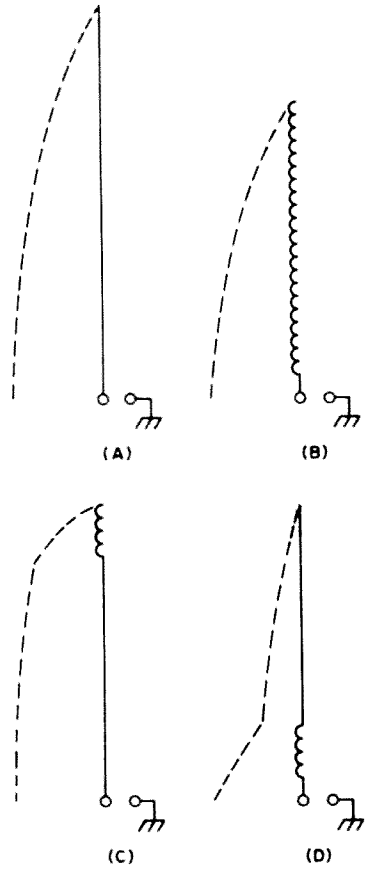


Fig. 1. The dotted lines show the current distribution on a full length ¼λ vertical antenna (A) and various forms of physically shorter, inductively loaded antennas.

produce the current distributions shown in Figs. 1C and 1D. Various points can be advanced for either top or bottom loading. Top loading has the advantage that the greatest current flow will take place in the metal rod section of the antenna and, therefore, less I^2R losses will take place in the loading inductor on top. Bottom loading has the advantage that the loading inductor can easily be bandswitched. Also, if the loading inductor is constructed of heavy enough wire, the losses can be held to a tolerable level.

Aside from placing the loading inductance either at the extreme top or bottom of the antenna, one could also place the loading inductance at the center of the antenna or place a portion of the inductance at the top and a portion at the bottom of the antenna. The current generation of mobile antennas generally uses center loading because of a

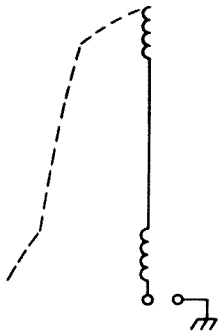


Fig. 2. Splitting the inductive loading to both ends of the antenna produces the current distribution shown.

combination of electrical and mechanical factors. The loading inductor need not be as heavy as a base-loading inductor to keep losses to a reasonable level, and the physical placement of the inductor allows a flexible upper section for the antenna, as well as access to the inductor for bandswitching by changing inductors. However, for home-station usage, the proper placement of part of the loading inductance at the top and bottom of the antenna, as shown in Fig. 2, has a better combination of electrical and mechanical advantages. The placement of part of the loading inductance at the base does not optimize the situation where the highest current flow is through the metal rod of the antenna, but it is also true in a practical situation that the most severe ground losses would still take place at the base of the antenna. So the actual increased loss that results as compared to solely top loading the antenna is a small price to pay for the convenience factors involved in bandswitching and impedance matching the antenna to a transmission line. The top loading that is used insures that a good portion of the highest current flow will take place in the metal rod.

Finally, the splitting of the loading inductance between the base and the top of the antenna greatly simplifies construction of the antenna for home station usage where a single long aluminum or steel piece of tubing is used as the main element of the antenna.

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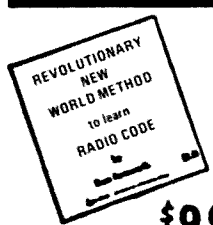
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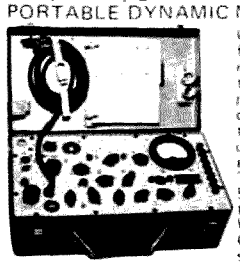
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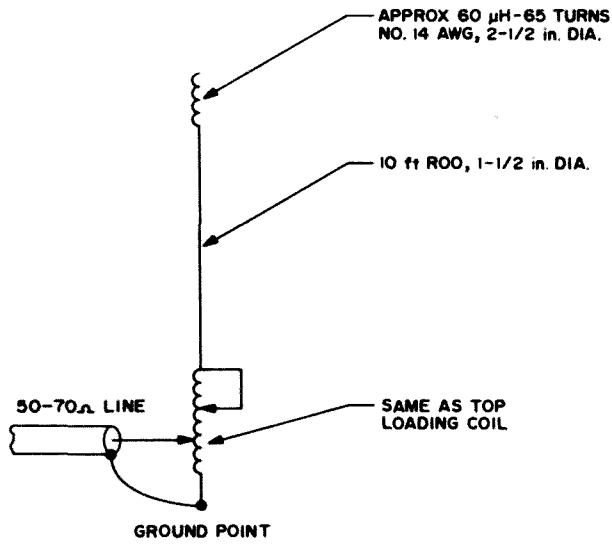


Fig. 3. Dimensions and coil sizes for 80/40m antenna.

Practical Example

Figure 3 shows a simple antenna using a 10 ft aluminum rod and top and base loading which I constructed for use on 80 and 40m. The maximum amount of top loading was utilized that would still permit enough base loading to be present on 40m so a coaxial transmission line could be tapped on the base-loading inductance for a proper impedance match. For the 10 ft rod, this meant a maximum top-loading inductance of about 60 μH. Since the top loading is fixed, this meant that the base-loading inductance has to be increased as necessary on 80m to resonate the antenna. Again, about 60 μH is necessary. The coil dimensions shown in Fig. 2 are those for which B&W or Air Dux coil stock is available. If possible, it would be desirable to increase the diameter-to-length ratio of one or both coils (maintaining the same inductance) so that the diameter is about half the coil length. This would raise the Q and improve the overall antenna efficiency. Such construction would make it more difficult to tap the transmission line on the base-loading coil but it should be easy to implement for the top-loading coil. The top-loading coil used is a salvaged coil from

a commercial trap-type vertical antenna. The necessary loading inductances for other bands or with other lengths of tubing can either be calculated from handbook data or it can be easily experimentally determined. In the latter case, the maximum amount of top-loading inductance is used on the highest frequency band that still allows a sufficient amount of base-loading to permit matching the transmission line. The base loading is then increased as necessary to resonate the antenna on the lower frequency band.

An swr meter is the only instrument necessary to adjust the antenna. Starting on the highest frequency band, the minimum amount of inductance is used in the base coil that permits the transmission line to be tapped on with a 1:1 swr. On the lower frequency band, the base coil tap is first changed to bring the swr down and then the transmission line tap readjusted to finally lower the swr. It may be possible to find a compromise tap point for the transmission so its position does not have to be changed when changing bands. The actual changing of the coil or transmission line taps can be done with relays or manually with clips, as desired.

Summary

No simple, short-loaded antenna will be extremely efficient on the lower frequency bands. However, the antenna described will work reasonably well for its size and it is a practical solution for a simple to construct and inexpensive antenna where space is limited. One point that should be carefully observed in installing the antenna is to provide a good ground connection either in the form of radials or connection to some large metal structure. If no ground connection possibility exists where it is desired to install the antenna and no room exists for radials, two antennas with similar loading coil arrangements can be combined to form a vertical dipole, or they can even be mounted at right angles to each other in the form of an L.

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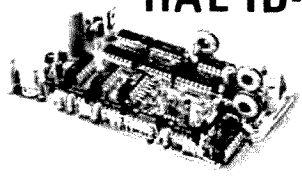
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MILESTONE WIN IN TOWER CASE

A classic victory for tower-owning has occurred in California recently. Some neighbors of such a man filed a lawsuit and got an injunction against the ham. The defending lawyer, also a ham, managed to win the case in favor of his client; in other words, the ham won. Rather than sit back and congratulate himself, the lawyer examined the injunction against his client.

In California, and possibly other states, such an injunction must be backed by a bond. The lawyer filed a claim against the bond for court fees, attorney's fees, and reasonable reparations (damages). The bonding company, it was found, had filed the bond to the wrong person and after much litigation, somehow managed to clear themselves and shifted the liability to the home owners who had filed the lawsuit and got the injunction.

The lawyer feels sure he will be able to collect fees and perhaps some reparations. The whole point is that a countersuit has been filed against the neighbors and the ham is in the driver's seat. Congratulations to the ham and his lawyer who did not give in under pressure and who have created a precedent in amateur radio.

IN OKINAWA...

BLIND HAM HONORED FOR PHONE PATCH SERVICES



Betty Blalock KR6BB, Awards and QSL Manager for the Okinawa ARC, presents the Okinawa DX Award for Ken Hinderleiter K7HQF, for service to the residents of the island. From left to right are Gordon Hale KR6RH, President of the Club, Ken, Mrs. Hinderleiter, and Betty Blalock KR6BB.

Ken Hinderleiter K7HQF, a blind ham from Phoenix AZ, has provided phone patches to the U. S. from Okinawa for over eleven years. Handling, on the average over 1,000 calls per month, Ken has performed a much appreciated service for American military personnel and their dependents. In appreciation of his service, the Assistant Secretary of Defense/Public Affairs invited Ken and his wife to Okinawa to attend the semi-monthly meeting of the Okinawa ARC to meet many of the people he has spoken to over the years. He was presented with an honorary membership to the OARC and he received the call letters KR6HT. At the meeting, Ken also was presented the Okinawa DX Award for the services he has unselfishly given, often placing calls in the small hours of the Arizona morning.

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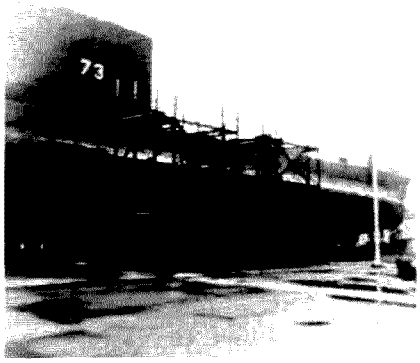
From May 14–21, 1972 the Barry College of Further Education Radio Society will be commemorating the 75th anniversary of the Bristol Channel Tests undertaken by Marconi and Kemp in May 1897. They will be establishing stations at Flatolm Island (GB3BCT) and Lavernock Point (GB3MKT).

The 1897 tests were significant in that radio signals were transmitted for the first time across water, radio signals were transmitted for the first time between two countries, and these were the last tests carried out by Marconi as an amateur. The 7th anniversary of such an event should not pass without special recognition.

The Society invites clubs located in areas which have an historical link with Marconi's early experiments to join in establishing special commemorative stations sometime between May 1972 and May 1973. The Society will award a special 75th Anniversary Certificate to radio amateurs who contact these stations. In the U.S. the Old Old Timers Club will handle the Marconi-Kemp celebration exclusively. Thei Vice President, William B. Gould K2NP, has been designated as the individual in charge of the project.

To emphasize the international aspect of amateur radio, overseas amateurs holidaying in Britain are invited to visit the historic site at Lavernoc Point, and operate across the stretc of water made famous by Marconi. special commemorative certificate will be issued to all amateurs operating this historic link. Any reader interested in visiting the site should writ in the first instance to K2NP, and Bill will be able to supply him with th necessary information for obtaining a reciprocal license. A special first-da cover stamp will be issued from Flatholm Island. Information on th stamp may be obtained (with I.R.C.) from GW3VBP.

News Pages



73 Strikes Again!

Latest addition to the 73 fleet is the surprised *Onondaga*, a Canadian Armed Forces submarine. Where will 73 strike next? Send in a picture when you find out.

International Net

MARCO SAVES LIVES

Jerome Hurwitz W3EZT, was in his Silver Spring shack on November 12 when he heard a distress call from Venezuela. The South American was in dire need of a special medicine for a two-month-old boy in Caracas. Jerome, an engineer by profession, served as a relay between the State and Defense Departments, Panama, and Caracas. Within 24 hours, the medicine was safely on its way to Venezuela from New York.

Although this is not the usual substance of ham radio, emergencies such as this do occur and it is only because of the operating skill of dedicated hams that tragedy is avoided. There is a special net that meets on the air just for the purpose of exchanging information of a medical nature. This is the Medical Amateur Radio Council, MARCO for short. This is an international effort to share medical knowledge and to lend assistance where possible. MARCO frequencies are: 7264 kHz daily at 0200Z; same frequency on Monday, Wednesday and Friday at 0320Z; 7060, Monday and Friday, 0230Z; 14060, Saturday and Sunday, 1800Z; 14280, daily, 0300Z; 14280, Sunday for DX SSB, 1900 and 2000Z.

NEWS BRIEFS FROM AROUND THE WORLD

CANADA *(Tnx to Canadian A. R. Federation)*

The Gifford Marsh Memorial Trophy has been presented to Noel Eaton for his selection as Ontario Amateur of the Year. The trophy is presented annually by the Radio Society of Ontario to the Ontario amateur who has given the greatest service to amateur radio on the local, provincial, national, or international level.

The official banned countries list for Canada is: Cambodia (Khmer Republic), Cyprus (except on national and international field days), Gabon, Iraq, Libya, Pakistan, Turkey, Vietnam, and Yemen.

Repeaters in Canada will be under official scrutiny by the DOC, but the exact date for policy notices and even what the proposals will be is not yet final. Any repeater licensee who wishes to keep informed about operation and who wishes to play a role in the formulating of regulations should contact A. M. Vardenbelt VE3FXC, 699 Trojan Ave., Ottawa 7, Ontario. He is the chairman of the CARF auto-repeater committee which is primarily involved in advising on changes necessary in regulations governing the licensing and operation of the machines.

Will there be Novices in Canada? This is a question that many a Canadian may ask himself before the CARF submits its proposal for a restricted class of license to the DOC. This license would allow activity in the VHF/UHF part of the spectrum, and the intent is to increase amateur activity there. What with more general radio service users looking for additonal frequency space, the amateur bands are good places to question if there is no activity there (U.S. hams, remember 11 meters?). Hopefully, the status of amateur will spur the newcomer to obtain full status. Several clubs have commented that they would conduct code classes on the air to help these hams up-grade. Another item that is related to licensing is the proposed lowering of the age requirement from fifteen to twelve years of age. To express your feelings on either or both of these matters, contact your provincial society before a proposal is submitted to the DOC. The proposal that will be offered will be based on the results of questionnaires that the Federation has requested of the provincial groups.

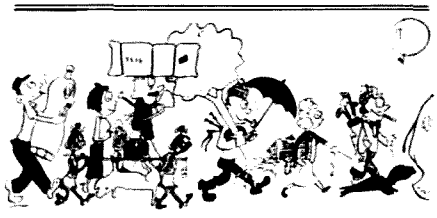
JAPAN *(MARCO News)*

The Hokkaido branch of the JARL has set up JA8IOC in Sapporo in conjunction with the Eleventh Winter Olympics. The objective is to inform listeners about the Olympics and to promote good will with other countries. Until February 13 they will operate CW and SSB on all bands 160 through 10 and six and two FM.

In early 1971, there were 139,400 hams, and almost one-third are in the Kanto area which includes Tokyo.

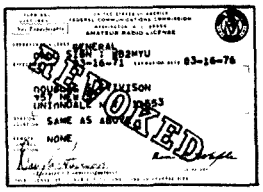
NIGERIA *(Courtesy NARS)*

There have been few new licenses granted to Nigerians due to the continuing political unrest that began in 1967. Negotiations have been attempted with the Post and Telegraph agency, the governing body of amateur radio in Nigeria, but very little has come of it. Advice that seems to be given to those who would attempt to re-open channels is to not make waves. Some groups have suggested showing films of ham radio activity over local television networks; however, the editor of NARS News recommends the opposite because "One of the aspects of this film is to recruit interested persons to apply for permission to operate a station, and if P & T were suddenly inundated with requests for licenses the reaction from P & T might be rather disastrous."



Moving? Please let us know.

WITH THE FCC



The Federal Communications Commission has passed an amendment to its rules to allow hams to increase speeds on teletype equipment to 60, 67, 75, and 100 words per minute. Previously, amateurs were limited to sixty words per minute, this limit mainly imposed by the type of equipment available. Now, however, more surplus TT gear is being released from commercial service and the ability to increase speed which has previously been denied is being allowed. Arguments in favor of the proposal included increased message handling capability and more efficient use of air time.

The FCC has recognized comments that this move is an advantage, as it promotes experimentation and will permit the development of new skills and techniques, in keeping with the basis and purpose of the Amateur Radio Service. Commission experience indicates that amateur operators have consistently demonstrated their versatility in adapting to new operating situations and conditions. The ARRL was one of the proponents of the measure, commenting that not restricting amateurs to specific speeds and codes would enhance experimentation and contribute to the development of new and improved techniques, experiment and practices.

No limitations to bandwidths were set as other parts of the Rules give indications of good engineering and amateur practices. According to the FCC release with this information, "This is in keeping with the intent of amateur rules to provide technical requirements which permit as much latitude as is practicable consistent with the prevention of undue interference between amateur stations and the prevention of interference to other radio services."

The FCC is there, so be careful to obey the rules. Richard Dixon WA8CKY, was cited for failure to have a licensed ham sign off his station, failure to identify at least once every ten minutes, and failure to file a notice of intended portable operation. Since Richard did not reply to letters to Show Cause why his license should not be revoked, his license was suspended for the duration of its term.

In other recent action, the FCC has revoked the Novice class license of Peter Kuehn WN6IER, Walnut CA. This is the result of improper use of his Citizens Band station, using excessive power, and off-frequency operation. His license is suspended for the remainder of its term, unless Kuehn wishes to appeal the suspension order.

An awareness of the rules is helpful. When someone receives a letter to Show Cause, it is not a suspension notice. It is the person's opportunity to tell what happened in his own words. No response is regarded as an admission of guilt and appropriate action is taken. A suspension order is then issued. If the accused wishes to challenege the order, he may make application for a hearing at which time the suspension notice is held in abeyance until the conclusion of the proceedings.

HOT GEAR

SBE SB-33 S/N 103906. Thieves broke wing glass and rolled down window to avoid setting off alarm on door. Charles Greene WA5JGU, 3028 NW 33rd St., Oklahoma City OK 73112.

Heath HW22A Transceiver S/N 907-18375. Richard Roberts W1BDX, P.O. Box 4, Rochester NH 03867.

National HR050 S/N 2800019. William Vance, WA5DQF, 410 Lakeside, Channelview TX 77530.

Hallicrafters SR160 S/N 416000-108039. Mike O'Grady K9YVA, 4611 N. Kenton Ave., Chicago IL 60630.

Drake TR3 S/N 3858. Virginia Voyles WA9EYL, East Main St., Petersburg IN 47567.

Collins KWM2A S/N 13815. Morgan Godwin ARRL HQ.

Collins 312B4 S/N 59920; Col 30L1 S/N 40084; Col MP1 S/N 44507; Col MM1 (mob. mike), Misco minispkr. Det. Sgt. W. Hopkins, Wilmington Delaware Police.

Swan SW175 S/N 426-5. Roger Sawyer WØAXT, 186 Lakeview Dr., Mason City IA 50401.

Reg. HR2A S/N 04-05896. John Crosby K4GBL, 4041 Compton Circle, Powder Springs GA 30073.

List from Past Issues:

Mfr., Model, Ser. No.	Owner	Issue
Halli., SR46A, #446100	WA1EMU	9/71
Reg., HR-2, #04-03505	WA5BNM	11/71
Sonar, FM3601, #1003	WB2ARM	11/71
Coll., 75A4, #804	WØMGI	12/71
GE, Portable, #1041218	K2AOQ	1/72
Coll., 75SE-B, #15640	Col.St.U.	1/72
Coll., 21S3, #12000	Col.St.U.	1/72
Coll., 516F2, #1649	Col.St.U.	1/72
Simp. Mod-A, #35457	W2PWG	1/72



According to the *DXers Magazine*, we find the following items of interest: AC5TY can be found nightly on the SEA net at 1200Z and goes down to 14305 kHz with 4S7AB. QSL goes to T. Yonten, Thimphu, Bhutan via Calcutta, India. You can list the Republic of Nauru under its prefix of C21, C20 and C29. Portuguese Timor can be found on fifteen and the call is CR8AG. Adriano only recently arrived there but will have his quad up soon. If you work the Pacific Net, look for TJ1AW (QSL via K4MPE). For non-DXers, this is the Cameroons. And for lower frequency DXers, Christmas Island, VK9XX will soon be on 40 and 80 meters. Higher frequency DXers can find him around 14,285 at about 0930Z. In either event, QSL via Stu, W2GHK.

Is UA7KAE/7 really in the South Shetland Islands? That's what his QSLs say.

Fred, VP8KV, Falkland Islands might be found on 14230 SSB around 1015Z and he can be reached at Box 144, Port Stanley, Falkland Islands. The W6's have been working VR1AB, British Phoenix Island between 0500–0600Z around 14285. If you need Brunei and have not yet worked VS5CB, you will be upset to learn that he will soon be QRT. You will be pleased to learn that VS5PW will be on the air soon with a kw. ZK1CD, a real gentleman, will QSY to help others earn the 5BDXCC. He is on the island of Rarorongа in the Cook Island group. Another one to watch for is 3B8CZ, Mauritius. Den can be found around 21300 and also on ten meters. QSL via RSGB. P.O. Box 467, Port Louis, will reach him direct. Togo, 5V7GE(?) skeds K4SKI daily on 14250 at 2100Z, give or take a little.

Only active XU is XU1AA, and he operates only from 0000–1500Z. The FCC is permitting American hams to work ONLY this XU station. QSL to XU1AA, University of Phnom Penh, Box 484, Cambodia.

Some other QSL info: VQ9R, Carl, Box 193, Port Victoria, Mahe, Seychelles.

VK Ham Tours Italy & U.S.

Ian Williams, VK3MO, has made many DX contacts from his Melbourne QTH, and so begins a happy tale.

Ian left Australia about the first of 1971 and soon arrived in Italy. There

he purchased a bicycle and toured the continent, stopping off wherever possible to visit the many stations he had contacted before. Of course he did not meet hams everywhere and frequently camped out in fields or construction sites. Twelve thousand miles later the bicycle broke down completely. Ian then decided to visit the U.S. Traveling here was a little easier as he obtained a special bus ticket that allowed him to travel anywhere at any time within a certain time limit *(This ticket is available only to foreign visitors –Ed.)*

In the U.S. Ian had eyeball QSOs with the Americans and operated their stations when possible. In fact, Ian had developed a following of interested and well-wishing hams on both sides of the ocean and kept them all informed as to his welfare. By now he is back in Australia, working more DX stations and perhaps getting ready to ship out again.

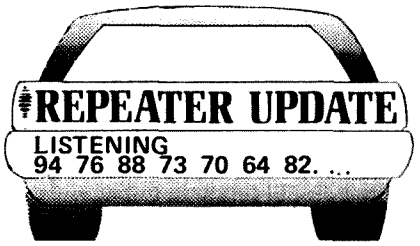
Year round DX may soon be a possibility, even during sun spot cycle low points. The National Oceanic and Atmospheric Administration has been conducting research on heating the F-layer of the ionosphere, and possible results might be ways of altering this layer to produce long range radio communication. These experiments extend the ability of man to alter his environment from a distance with no harmful after-effects. So far, the heating effect has been controlled with results lasting seconds, minutes, and sometimes hours.

Results of these studies will prove useful for space as well as intraterrestial communication.

Eric 5N2ABG, reminds us that there is a small independent territory between Norway and Sweden called Morokulien. It is an international refugee area and the prefixes LG and SK9 have been specially issued. LG5GL and SK9WL are active from the territory, and QSLs may be sent to P.O. Box No. 1, N2242/S 67 044, Morokulien, Scandinavia.

Egypt, SU1IM, has been heard around 14057 at about 1500Z, and this is on an almost daily program. Also on 20 CW is VR5FX, Tonga. Usually showing between 0500 and 1730Z, he can be found around 14040, up or down about 5 kHz (QSL via ZL2AFZ). And still another 20 meter man is Keith VKØKA, MacQuarrie. Keith is found regularly on SSB, probably around 1700Z with a good sig to the west coast. QSLs for VKØKA are handled by the VK3 Bureau.

And if you need Africa, listen in to the West Africa Net daily at 21300 kHz.



Interesting note: Varitronics transmit crystals can be used in the Regency HR2. With this change, the 73 Varitronics crystal becomes Regency 76, the 91 Varitronics becomes 94 Regency . . .

AL	WB4QFR	Phenix City W1.8	28–88
CA	WA6ALV	San Bernardino Mtns. T1.8	34–85
FL	WB4KNQ	Merritt Island formerly 34–76	28–88
MA	W1CSF	Pelham	13–53
ME	WA1KGZ	Streaked Mtn. (Buckfield) (Delete W1QXR, W1EFF)	34–94
MI	WB8CSC	Ann Arbor	37–97
	WB8CQS	Detroit PL 100 Hz	34–76
	K8VLN	Detroit PL 100 Hz	46–64
MN	KØRTU	Elk River T1.8	34–94
NM	WA5QLZ	Albuquerque	28–88
NY	K2LDT	Boston	31–91, 34–94
	K2LEQ	Voorheesville	07–97
	WA2UYO	Cherry Creek	31–81, 34–146.147
OH	K8HRS	Ashtabula formerly K8EUR	34–76
TN	K4RSV	Lenoir City	46–706
WI	WA9ZEF	Appleton T1.8	34–76
CANADA			
	VE3BER	Pt. Colbourne	449.40–146.70 07–70

MARS repeaters are being built now and the standard frequencies for them are 148.01 in, 143.99 out. Two such machines are in Ridgefield CT and Beverly MA, and there are plans to have a series of similar repeaters on a Maine to Virginia network.

NEW PRODUCTS

WA6JOX has returned a Consumer Test report about the Vanguard Model 201 rf preamp. His evaluation says this is the "most accurate advertising spec ever seen. Very good product." And as for servicing problems, "None, easy to use." Dick recommends this two meter preamp very highly.

FREQUENCY MODULATOR FOR THE GONSET COMMUNICATOR

The Communicator has been the most popular two meter transmitter-receiver of all time. But it is an AM rig and two meters is now almost exclusively FM. Palomar Engineers' new Frequency Modulator puts the Communicator on FM without any modification or rewiring. The microphone plugs into the Frequency Modulator. One of the cables coming out of the Modulator plugs into the Communicator's microphone jack and carries the push-to-talk line. A second cable has the crystal plug which plugs into any one of the Communicator crystal sockets and the crystal plugs into it. A variable capacitance diode in the crystal plug frequency modulates the crystal and the frequency multipliers in the Communicator increase the deviation to about 8.5 kHz at the output frequency.

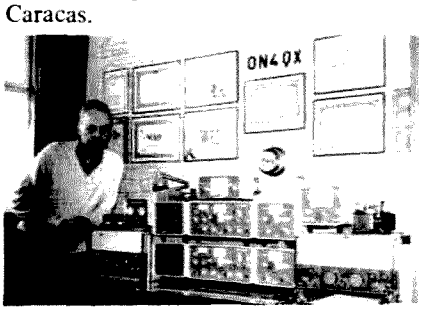
(continued on page 8)

The Japan DX Association (P.O. Box 7, Aobadai, Yokohama, Kanagawa, 227, Japan) is negotiating operation from such tantalizing locations as Burma, Bhutan and Iraq. The effort is being aimed at the Japanese Embassies in these locations. Different companies are being contacted as to equipment and travel considerations, too. And there are other possibilities of bringing on some of the rarer DX. Hopefully this will come about, giving many a DXer some new ones to chase after.

In an effort to promote meaningful communications among hams, the Electronic Representatives Association Ham Club has sponsored a contest among their own members and hams in Venezuela. "Eyeball to Eyeball," the project theme, expressed the desire of many hams to meet face to face with the voice on the other end.

Mr. Dave Hollis, the Club chairman, said "Venezuelan and U.S. amateurs who have contributed the most to promote this theme will be presented with a special prize for their accomplishments. Awards are being donated by prominent electronic equipment manufacturers."

The receipt of a QSL card from the American ham permits the Venezuelan operator to attend as a guest the banquet at Interface 2, the ER's 13th annual marketing conference, held at the Macuto-Sheraton Hotel in Venezuela. In order to continue face to face contact after the conference, the ERA Ham Club has received permission from the Venezuelan government to operate ham stations from Caracas.



DX station ON4QX (Bob) since 1936. He is an A2 op. DX 320/300, 294 CW, WPX 848, and a regular reader of 73. He has 250 awards and DX licenses 3A2CZ, ex-IL1QX, LX3QX, 9A1QX, PAØQX. Bob is an ex-radio officer of the British Navy.



EDITORIAL BY WAYNE GREEN

Columnists Wanted

For some ten years now we have avoided running much in the way of monthly columns in 73 . . . but now, with the concept of the newspages, perhaps the time is ripening. What I have in mind is a far cry from the four and five pages of rambling gossip that columns in some other magazines have been running. I'd like to see a short report on activities and news each month as a one-column feature in our newspages. If news is short, the column should be short.

Have we any volunteers to handle monthly reports for our newspages? I'm interested in people who are already expert on their subject, who already have most of their sources of information developed. I would entertain the idea of columns on RTTY, ATV, SSTV, DX, 160m, 6m, FM, 220 MHz, 432 MHz, moonbounce, certificates, contests, ARRL, ICs, Novices, YLs, traffic nets, or what else do you suggest?

I have in mind a column that would run maybe two double-spaced typewritten pages a month . . . plus perhaps one picture. Short and sweet.

Payment? Fame! Also little extras such as your own personalized QSL cards, letterhead paper, a Life subscription to 73, copies of new books as we publish them, and a small cash payment to cover your postage and expenses like that. Fame, mostly.

If you would like to manage a column sit down now and write up a sample of what you have in mind and send it in. Remember that once you start you are responsible to a lot of people to meet that monthly deadline . . . the 10th of the month.

Repeater Pictures Wanted

The 1972 edition of the Repeater Atlas is about to go on the press and we would like to include as many pictures of repeater sites as we can. Have you a good interesting picture of your repeater?

220 News

React has announced that it now supports the EIA proposal for setting up the citizens radio service in the amateur 220–225 MHz band. The full EIA proposal was printed in tiny type in the March 1971 issue of 73, page 124ff. React has petitioned the FCC to act quickly on the EIA proposal. How many of you who have read the EAI proposal prefer it to the "hobby class license" proposal which would still permit amateurs to use the entire 220 band?

Massive CB Antenna Announced

One of the EIA manufacturers has announced a "massive CB mobile antenna" which is guaranteed not to burn out in CB installations.

Photographs Needed

We would like to do some picture stories on the various aspects of amateur radio and would like to have some good illustrations.

We would like to have some good up-to-date illustrations to accompany a series of articles on the various aspects of amateur radio. How about it, you photographers out there, can you come up with some nice 8 x 10 glossy black and white photos showing the following?

1. A workbench with test equipment and tools with a partially built piece of ham gear on the bench.

2. A picture of a shack, complete with operator, obviously a DX op from the QSL's on the walls, neat and using equipment which is advertised in 73.

3. A slow-can television setup, perhaps with a good looking chick watching.

4. A ham-TV station, perhaps some enlarged test patterns on the wall. Could there be a chick here too? A girl makes things look ever so much more fun.

5. How about an RTTY shack photo?

6. There must be a gorgeous looking Novice out there somewhere . . . well, perhaps not, maybe then a Novice shack with a lot of QSL cards?

7. Yes, we need a 2m FM operator, probably in a car with rig showing plainly, and no QSL cards at all.

8. Let's not forget the VHF nut and his barrage of antennas . . . please, a nice VHF antenna picture.

9. Then there is the super DX VHF nut who works via moonbounce . . . dish pictures needed.

10. Club activities should not be forgotten . . . perhaps your club might pose for a big picture! With any luck I'll be able to get this into several magazines and perhaps a booklet or two. You'll all be famous.

11. If anyone can come up with a good picture of a mass of mobiles, whips showing, that could be a winner, too.

12. An interesting hamfest or convention shot showing a lot of hams having fun could be a winner.

13. Have you any good shots of contest operating such as Field Day or one of the VHF contests?

14. What did I forget? You think of it and send in the picture.

Good pictures which are acceptable for publication will bring $15 for the first in a category and $5 for each after that. Good pictures of girls doing something hammy are always needed. Licensed girls pay even more. Beautiful licensed girls pay a premium. Gorgeous sexy girls who are hams could bring you even more than a premium. And, say, don't forget to include a model release when you have people in your pictures.

Audio Amateurs

Those of you who are interested in building hi-fi gear will want to check out a new publication, *The Audio Amateur, 307 Dickenson, Swathmore PA 19061.* Like me, it's thin, but fun.

Mobile Installation

Not many years ago an FM installation in the car was a great big deal. The transmitter and receiver went into the trunk of the car, the antenna took an hour or so to install, the control head had to be mounted up by the driver, and all those wires!

The other day someone temporarily defuncted my Rover 2000TC and I had to change to an Alfa Romeo for a few days. It took about five minutes to remove the two FM units (with amplifiers) from the Rover and about an hour (at the most) to set it all up in the Alfa. Not bad for two complete FM units, one running 100 watts output!

I decided to use the Volvo for a trip to New York so the equipment was changed again, taking perhaps a half hour this time. The Standard 826 and the Regency Transcan went on the glove comparment shelf, the two amplifiers under the seat. We ran heavy wires to the battery with clips and didn't even have to put in new wires, the same harness being satisfactory in all three cars.

The big difference is in the small size of the units and the magnetic antennas which just clamp themselves to the car wherever you put them down.

(continued on page 7)

Building Club Interest

Clubs will die off, given the chance by inept officers. The big problem is how to get them to expand. This isn't really all that difficult if you think of it from the viewpoint of the prospective member rather than as a club officer. The key to getting new members is to offer them fun and entertainment which will make them want to come to meetings and participate in club activities.

Before I give you hints on how to attract members, may I take a moment to give you some good hints on how to kill off your club fast?

1. Rather than have the basic business decisions for the club made by a small executive committee, bring all matters up for discussion and agreement by the whole club. This will greatly entertain everyone by getting them into arguments and fights for hours at a time, frequently occupying the entire meeting period.

2. Exhort members who have shown little interest in coming to meetings or participating in club activities to shape up and stop leaving all the hard work to the little clique which has taken over the running of the club. Make them feel good and guilty about their laziness.

This list could go on indefinitely, but you get the idea.

Okay, now down to business . . . getting members. You are going to keep business out of those meetings as much as is humanly possible, right? You're going to have a nice coffee and doughnuts after each meeting, right? You're going to arrange to have interesting speakers and let everyone know they are coming, right? You're going to have a club bulletin full of reasons why the club is fun, right? You're going to wrack the brains of the elite clique who has taken over the club to think up more and more reasons why hams will have fun at meetings, right? You're going to have things going on that will interest Novices, right? You're going to make sure that the better known and more interesting amateurs in your area attend the meetings and that everyone knows they will be there, right?

Perhaps the idea comes through. You have to sell prospective members on the fun they will have at a meeting. You may find a short interesting film will help . . . a manufacturer of ham gear is often fascinating . . . an RTTY member will often just about break his neck to put on a demo and try to sell everyone his passion . . . ditto slow-scan television . . . and even regular television . . . and watch out for the repeater fiends, they are the most virulent of all and if you give them much time on the program they will have the club setting up a repeater in no time at all . . . and perhaps a repeater is a better club project these days than a club station? . . . and what club hasn't at least one member who has been traveling and can't come up with slides of Tonga or some damned place to make everyone else eat their heart out . . . you should have at least one inveterate builder who can take at least part of a meeting to show his latest TTL logical QSL-answering automatic transponder and keyer . . . and all this can be whipped to a frenzy of anticipation in that club bulletin.

You don't have a club channel on some band? Maybe on the club repeater? Well? And don't fight it if the SSTV fanatic wants to zip some of his pictures through the repeater now and then just to zing some of the other members into setting up a scanner. Or perhaps the TT nut should have a little time to send some of his diddle-de-diddle over the repeater to another typer. If you get members too excited over these things you may find a second TT repeater being set up for 10–70 and maybe even an SSTV repeater? Not likely.

That club bulletin . . . that is your workhorse . . . use it to let all prospective members know how much fun everyone is having at the meetings . . . use it to make them want to be at the next meeting . . . this is your advertisement to get more members so don't worry about the postage to inactives, if they don't see your ad they'll never come. Can you get each "active" member of the club to accept the responsibility to call one "associate" member (prospective member) and urge him to come to the next meeting? . . . everyone has been asking about the "associate" . . . they all want him to come . . . etc. Of course this all falls flat if the fellow finally comes out of his shell for a meeting and is royally ignored. The chap you see standing over there in the corner is attending his last club meeting.

Collinear Antenna Dimensions

Back in July we ran an article by K6MVH on a two meter collinear antenna. This article created quite a lot of interest in this easily constructed high gain vertical antenna which is so ideal for FM operation.

The antenna article was pretty good with one little exception . . . the dimensions of the antenna never made it to the printed page. That was an editor's "oops." It was particularly an oops for an editor who was printing his own article and who prided himself on being infallible.

A correction of the oops eventually made it through the mills and, for those who could find it, appeared obscurely somewhere in the pages of fine print. The correction left something to be desired too. Apparently the antenna in question was originally written up in the FM Bulletin by VE3BXA and a bit got lost along the way.

Referring to the 73 Coax Handbook, we find the following dimensions for antennas and coax which are pertinent. A half wave is double the quarter wave dimensions.

Dimensions: Let 146.5 MHz=(a), 222.5 MHz=(b), and 440 MHz=(c). Then the dimensions for a quarter wave antenna would be (a) 20.15 in., (b) 13.25 in. and (c) 6.71 in. A quarter wave of RG-8/U polystyrene coax would be (a) 13.3 in., (b) 8.75 in. and (c) 4.43 in. A quarter wave RG-8/U foam coax would be (a) 16.1 in., (b) 10.6 in. and (c) 5.37 in. Half waves are twice quarter waves.

The Coax Handbook also gives the dimensions for full, half and quarter wave sections for all amateur bands from 80m through 1296 MHz for antennas and coax with Polystyrene, Teflon, Amphenol Polyfoam and Beldem Foam.

The diagram in the article can be deciphered by substituting the numbers under "antenna" in the above chart for (a) and the other RG-8/U numbers for the (b)s. (c) = 2(b).

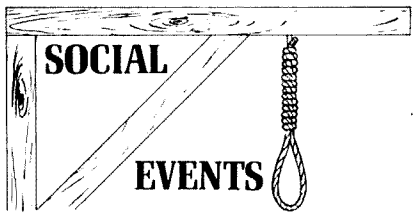
Some of the PURPOSES of the Institute of Amateur Radio

1. PR for amateur radio to improve the public image of the hobby.
2. PR for amateur radio with members of Congress.
3. Encourage newcomers to get their amateur radio licenses.
4. Encourage amateurs to upgrade their licenses.
5. Provide study guides to assist amateurs in upgrading their licenses.
6. Encourage clubs to be started and to grow.
7. Encourage amateurs to build and experiment.
8. Encourage amateurs to try new facets of their hobby.
9. Work with any willing organizations toward a stronger hobby.
10. Encourage planning for the future expansion of amateur radio.
11. Encourage international planning for ITU conferences.
12. Encourage satellite amateur radio communications.
13. Encourage amateurs to take an active interest in regulation changes.

YOU *CAN* HELP! Will you?

The newspages of 73 will carry Institute news to all active and interested amateurs. If you have information on any of the following it will be

(continued on page 9)



GATHERINGS

Fun for all is guaranteed at the Navy-Marine Corps MARS Picnic, Swapmeet, Auction and Hamfest. Everyone is invited to this gala festival of exhibits, displays, and fun. Hourly prize drawings, ladies' prizes, and auction (2 P.M.) are only some of the features of this get-together. April 16 is the date, 10 A.M. is the time, and it's at Adobe de Polomares, Pomona CA.

The Ninth Annual International Hamfest will be held at the International Peace Garden between Dunseith, ND, and Boissevain, Manitoba. The dates are July 8 and 9. Hams from California, Washington, Minnesota, North Dakota, Saskatchewan, and Manitoba have attended in the past for the gathering. How many more places will be represented there this year? Contact Mel McKnight WAØSJF for more details.

In Mansfield, Ohio, the Intercity Radio Club will hold its annual Ham Auction at the U.S. Naval Reserve Training Center on Friday Feb. 4 at 6 P.M. Address of the Center is 170 Ashland Road in Mansfield. Donation of one dollar at the door.

On February 20, the Toledo Mobile Radio Association will hold its 17th annual auction at the Lucas County Recreation Center, Maumee, Ohio. There will be exhibits by manufacturers and door prizes to add to the festivities.

The Playground ARC, Fort Walton Beach, Florida, will host the second annual Florida Boondocks Swapfest on March 19 from 8:00 a.m.–5:00 p.m. at the Community Center on Highway 98. Talk-in stations will be on 94 direct, 34–76, and 3957 kHz. Tickets available from PARC, P.O. Box 873, Fort Walton Beach FL 32548.

Watch for Special Events Station WY3MCA between January 23–30. This is the Severna Park YMCA ARC commemorating National Y Week. Phone and CW operation is planned on all bands, and a Novice station will be on the air also. Each contact will receive a special QSL.

The Texas VHF-FM Society will hold its winter meeting in Corpus Christi on February 26–27. Saturday's program begins with registration and in the afternoon progress reports from the different repeater groups of the state will be given. The evening offers a technical session that continues until all questions are answered. Sunday will be a variety of business meetings and speakers about aspects

MICHIGAN

Blossomland Amateur Radio Association presents its annual ham auction, Sunday, March 12, at the Shadowland Ballroom, St. Joseph, Michigan. Doors open 7:00 A.M. Admission $2. Auctioning free. Display tables available with one-half acre under roof. For additional information write: BARA, P.O. Box 175, St. Joseph MI 49085.

CONTEST

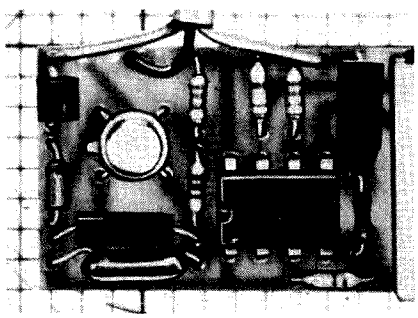
The Itchycoo Park VHF ARS announces the second annual World-Wide VHF Activity from 1900Z March 11 until 0300Z March 13. The purpose of the Activity is to promote VHF and to provide a testing ground for new systems during an otherwise low-activity period. To make a contact, exchange call and state. Foreign stations exchange province or country and call. Any amateur band above 40 MHz is acceptable. To score, multiply contacts times states, provinces, and countries worked. A station may be worked once per band. Recognition certificates will be awarded every ham station that meets either of two requirements: fifty contacts below two meters, or twenty-five on two and ten on any higher band or bands. Special endorsements will be given for the top scorer in each call area or country.

Logs should show date, time, freq, state, and call. All modes are acceptable. Logs must be postmarked by April 15, and send them to WA3NUL, Itchycoo Park VHF ARS, Box 1062, Hagerstown MD 21740.

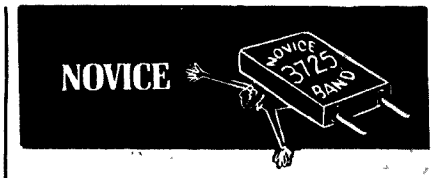
NEW PRODUCTS *(cont. from p. 5)*

The Frequency Modulator works with any of the Communicators. Built-in tone burst is available for use with repeaters. A carrier frequency adjustment allows the frequency to be set exactly. Other modulation, such as FSK, can be applied to the frequency modulator. The unit is priced at $34.50. Built-in tone burst is $10. Communicator model and tone burst frequency must be specified with order. For more information write to *Palomar Engineers, Box 455, Escondido CA 92025.*

TONE BURST ENCODER



Tone burst activated repeaters no longer pose an entry problem to walkie-talkie owners who have the Ross and White model TE-P tone burst encoder. This is a single tone encoder that is field adjustable from 1700 to 2500 Hz. Since most hand-held units are ultra-compact, R & W will handle the installation for a fee, setting the freq to your request. Drop a line to *Ross and White at 50 W. Dundee Rd., Wheeling IL 60090* and tell them what you have so they can quote you a price for the unit and installation.



As Wayne wrote in the December issue, it is kind of rough as a Novice to explain ham radio with a demonstration. Frequently it is a matter of impressing your parents' friends with those electronic gadgets in the basement. Those bleeps and boops are not too intelligible to the average member of the bridge club. Their impression of ham radio depends on you and how you show off what you can do. Here's the way I used to do it, and it has proven to be successful for others.

Tell the listener what has been done, what is being done, and a hint of things yet to be in amateur radio. A little history of amateur radio, with the early wireless experimenters is a good point at which to begin. Only one or two names are necessary, and no mention of spark gap. The fewer technical terms you use, the fewer you will have to explain. Also, you don't look as though you are showing off. Explain a bit about some developments in electronics in which hams have been in the vanguard, such as transistors, computers, television, satellite and moon-bounce. You can touch on the public service aspect of the hobby but do not make it sound as though you personally handle life-or-death traffic every day. In almost ten years of operating, the most urgent message I handled was a mother wanting her son to call home immediately. If you are asked what traffic you have handled, explain what type, if any, or what type you are prepared to handle. Remember that

(continued on page 9)

there are Novice and slow speed nets that you can participate in.

All of this should take about three to five minutes. After you have begun, you can turn on the rig and slowly and absent-mindedly tune around the forty or twenty meter bands, two of the more active frequencies. Next you can explain a little about the licensing requirements and that you are at the beginning step and will soon have a higher class ticket that will permit you to operate without restrictions such as you have now. Now mention a few of them. Show your guests a crystal, how you keep a log, and tune in a few stations for about ten to fifteen seconds each, but move slowly enough so that if one of your guests hears something interesting, you don't lose it. If your visitors are ladies, tune to the high end of twenty to get some of the YLs that often are there. You can explain that there are a lot of women involved in radio and that they are among the more proficient operators. Let them hear Morse code also and listen to a station that is going at about your speed and translate a bit of it. Remember they don't know the code and will hold you in regard as a skilled op even if the station you copy is going at about four words per minute. Compare your speed with a fast CW man and explain that you are not that proficient yet. They will asssume you have false modesty and are really that good anyhow. You have now taken up about eight or ten minutes, which is about all they wanted in the first place. Answer any questions that come up, including the request to call someone.

Do not give the excuse that your antenna is down or that no one is on. Tune up your transmitter (into a dummy load, of course) and explain that you are tuning up. "What's tuning up?" someone will ask. Tell them that it is like getting the air and fuel mixtures right when tuning up a car, or getting everything set so that the final tube will like the electrical qualities of the antenna. Finally, the moment everyone has been waiting for . . . a real live broadcast from a radio ham. Tell them you will call CQ or answer one if you hear a loud one. Tell them also what CQ means. Inform the awe-struck voyeurs that you probably will not make contact due to the odds against it happening just when you would like most to demonstrate (Murphy's Law). This way they are only a little disappointed if you are right, and really ecstatic if you get someone. Look calm if you do get someone.

While the other guy is giving you a call, explain what you will say, but keep it short, like perhaps RST, QTH, and that you are showing off. Do pretty much the same if you can operate phone, and on your next transmission give the mike to someone who wants to talk. NEVER force anyone to say anything over the radio if they don't want to. Translate what the other ham says as he is saying it (it's better to copy in your head than on paper). Answer any questions the ham might have in your next message and tell him that you have to go back to your guests. Of course, you have told your guests that you'll say this and often they'll say, "Oh, no. Don't stop on our account. You go ahead and talk with him and we'll go back to playing bridge." If this is the response, you need not sign, but can carry on as usual.

If you didn't get a reply, they'll still excuse themselves so that you can be disappointed and embarrased in solitude; but you expected no reply anyhow. So you can call CQ again on your own time. If your guests stay on, talk some more with them and answer questions. The shack will speak for your prowess as a radio experimenter so there really was no need to prove it other than to show off a bit and to inform and impress the visitors. Your QSLs on the wall, the DXDC certificate, the map with the colored-in states all attest to your ability. A neat shack is more sophisticated than the rustic rat's nest, and it shows a professionalism that the latter lacks.

Your station is a reflection of you, the operator, and how you keep it organized reflects on you. Your presentation of what ham radio does is the impression you leave with your guests and friends. If your license prohibits you from making a remarkable demonstration, make it a good one instead.

. . .K1NUN

de W2NSD *(continued from page 7)*

of value to all amateurs if submitted for publication.

a) Events where amateur radio has helped save a life or helped someone in trouble.
b) Legal or other possible threats to amateur radio.
c) Events where amateur radio has made the national news.
d) Legislation pending of interest to radio amateurs.
e) Sources of speakers, films, etc., for radio clubs.
f) Hamfests picnics, conventions, dinners, exhibitions, etc.
g) Lists of stolen ham gear to help dealers locate missing equipment.
h) Stories of amateur radio demonstrations to government officials.
i) DXpedition stories and pictures which would be of general interest.
j) Certificates being made available.
k) Contests of general interest.
l) News of unusual feats in amateur specialties such as SSTV, RTTY, ATV, etc.
m) Satellite news in as much detail as possible.
n) User reports on new equipment, good and bad.

Rather than set up an expensive system of issuing membership certificates and pleading for money and members, 73 is funding the operations of the Institute of Amateur Radio 100%. This includes all functions of the Institute such as the issuance of certificates which make operating a lot more fun for the newcomer to our bands, the sending of selected copies of the Amateur Radio Newspages to all members of Congress to help promote amateur radio where it really counts, in Washington, encouraging the publication of the most extensive and complete license study courses written specially for each grade of license exam, the publication of material to help clubs to be formed and grow, the publication of state-of-the-art construction articles to help amateurs have the fun and education of building their own equipment, the supporting of DXpeditions, the supporting of amateurs in legal difficulties which could have an effect on all amateurs, providing speakers and support for important amateur hamfests and conventions, and a myriad of other projects.

With YOUR help amateur radio will be bigger and stronger . . . and MORE FUN for everyone! Please go that little bit extra and help.

Inexpensive FM Crystals

The Ed Juge ads tell us that Ed is carrying crystals for the popular FM channels in the 6 MHz and 12 MHz ranges for transmit, which should work with the Regency, Simpson, Drake, Telecomm, Tempo, Gladding and Sonar. The receiver 45 MHz crystals should work in all the popular ham rigs except the Gladding, Standard, and IC20/21 units. The remarkable part is his price of $3.95 each! This is cheaper than even I can buy them from the crystal manufacturers, and I've bought over $500 worth so far to help me test out the many units which I've reported on in 73.

. . .W2NSD/1

GOOD GRIEF, WE MADE A BOOBOO (ERRATUM)

On p. 43 of the December issue, there is an error in the diagram of the power supplies for the Morse Memory. The middle bridge rectifier of the three should have the diodes all reversed, and the NPN transistor should be a PNP. This will give the −9V dc indicated.

LETTERS

ou goons don't ever proofr
lousy
bunch of rocks
you ignored my comments in
I insist that you print ev

About a month ago I decided to get on 40 SSB and try to carry on a *conversation* with somebody. I was really determined. After trying every approach possible (almost), I determined that it was not as easy as I had expected. Band condx were good – perfect for a good conversation. After a couple hours, I gave up.

I think that, as you said, there is no simple solution. I think that the problem is even deeper than you suppose. QST has had numerous editorials and articles on this very problem for years. I would be willing to wager it will get worse before it gets better.

New York City can be the loneliest place in the world with all its people. I think if that changes, our problem on the ham bands might change; but probably not before then.

Well, the idealists that we are, we can't give up. Keep trying to crack away at our shells!

Re getting rid of phone patches – as you can get from my prior statements, I don't feel that simple solutions will do any good at all. I think that stateside phone patches are a good way to "impress relatives." Often, I run a phone patch for just the sake of showing a non-ham friend how the radio works. In that way, these are meaningful contacts. Nets are okay if they serve a purpose (such as WCAR). Nets, formed just to talk, sometimes produce more meaningful conversation than single QSOs.

Gregory Ginn WB6ZNM
Hemosa Beach CA

Sorry about the late renewal but if I get one of those books I think it was a good idea to wait. You are not the only people with money problems. Maybe you should have a student rate.

Your magazine is pretty good except sometimes you should have articles explaining things that some of us don't know too much about. Like the propagation chart in the back.

Another thing is some people think that 2m FM is getting a lot like CB. I tend to think along those same lines, since you never see construction projects (except for antennas) for it. There also seems to be a lack of interesting things happening in it. In HF just working distant places seems to be enough, or ragchewing with another state, but on 2m it seems to be just a telephone service. OK for people who want it but I like doing something spectacular with my license like building something or talking with some distant person with a rig I had something to do with. Plugging it into the wall and working someone just doesn't thrill me. If you could do something about that I would be very interested and I am sure others would too. There are also higher bands like 220 and 432 that shouldn't be left out.

Ken Dragoon
Portland OR.

In regard to the article in your December issue on a "Morse Memory;" I think I can suggest an improved method of programming the device; if the user has a keyer that functions by counting down from a clock, he could add the output with the clock base to provide the desired input code. This would facilitate rapid reprogramming of the memory and greatly extend its usefulness.

John McHarry WA9FCH
Wappingers Falls NY

Could not resist writing a short note after seeing you listed as NH LocSec in the July/August Mensa Bulletin. I've been a member of Mensa (and, while it existed, of MM) for several years. Often wondered how many hams were members of Mensa, but didn't even know one more before. Can you shed any light on the subject?

I've not been too active in local groups – move around too much (am now a Major in the Army), and often end up where local groups aren't. Have written for 73 (May 69), as well as the competition. Must confess that, after some bad experience with CQ (Sept. 68) I have decided I much prefer your editorial policy. Unfortunately, a year in Viet Nam, and my current efforts to get an MS in Computer Science, have interrupted my writing for a while. The ideas are piling up, though, and next year may be a different story.

Possibly a short explanation and query in 73 might unearth a few more HaMs (or produce a few more).

Dale E. Coy W5LHG
Rolla MO

Amateurs interested in joining Mensa, an international club of people in the top 2% IQ, should write to Mensa, 1701 W 3rd St., Brooklyn NY 11223 for details. There are quite a few hams in Mensa, by the way. I dunno why.

I recently visited India on a business trip and had the good fortune of being able to meet some of the ham fraternity in Madras, India.



Back row, left to right: Rao, Venkata, Gokula; Front: Chauman VU2MZ, Bernie W9HTF, Savoor VU2RS and George VU2GF.

The Madras Amateur Radio Society held a special breakfast meeting for me where I got to meet and talk with them. They appear to be in favor of most of your stated ideas concerning amateur radio and feel that 73 is the most useful ham magazine for their purposes. They are a fine group of hams and SWL's. The 20m band is open to the U.S. from 1030 to 1230 GMT, and they are on 14.1–14.2 MHz and welcome DX break-ins. If the band is opened to U.S. hams below 14.2 they will move lower in frequency. Most operation is AM and CW but Savoor, VU2RS has just acquired a Yaesu and is on SSB. Chauhan VU2MV recently obtained a model 19 Teletype unit surplused by the Indian Army and hopes to be on RTTY soon.

By the way, they can obtain a reciprocal license for U.S. hams in 2 days.

Bernard Ostrofsky W9HTF
Gary IN

Articles on TTL logic, like the one by Darrell Thorpe in the December issue, are needed.

Please print some more of these. You might start with one on how to make an input circuit for a counter that uses TTL.

Present prices on these IC's must make them about the hottest item around.

Eugene H. Beebe W6SSB
Long Beach CA

DEPT. OF AMPLIFICATION

Carl C. Drumeller recommends in his article "Biasing the Transistor Audio Amplifier" in the November '71 issue of 73 that the "cookbook" method of amplifier design be dropped in favor of what is essentially an intelligent cut and try design procedure. In this letter I will expand some of the author's comments on common emitter, CE, amplifiers and suggest a design procedure that is a little more scientific than "cut and try."

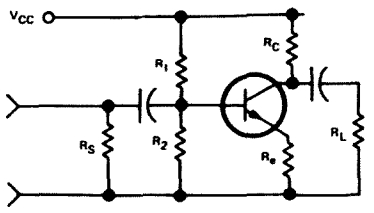
The author correctly states that "Active devices, whether vacuum tubes or transistors, vary in characteristics from one sample to another," but for transistors used in low level audio amplifiers usually the only important parameter that varies widely is

beta, or the forward current transfer ratio. Alpha, or the common base current gain can usually be assumed to be 1.0, and the forward biased base to emitter voltage for a silicon transistor is generally about 0.7 volts. The key to good design is to design circuits that have low sensitivity to beta, then virtually any transistor of the correct polarity and adequate voltage ratings will work.

Thermal runaway should not be a problem in low level CE amplifiers. For thermal runaway to occur in a circuit, an increase in collector current must result in an increase in power dissipated within the transistor. If the transistor in the CE amplifier is biased such that V_{CE} is less than ½ V_{CC} the reverse is true and thermal runaway can't occur.

I disagree with the philosophy of tailoring the bias network to an individual transistor for three reasons. First, even though replacement may be seldom, it is quite a bother to redesign each time. Second, the breadboard circuit usually winds up in a box of some kind where things may get a bit warmer than out on the bench. That carefully tweaked circuit may be a bit off as the temperature goes up. And finally, the gain that results from a cut and try procedure will vary widely. In a feedback circuit this could be disastrous, turning an amplifier into an oscillator. Knowing what gain you will wind up with is usually better than extracting that last dB of gain. After all, transistors are cheap now. If you need the gain, add an extra stage.

A reasonably easy design procedure that gives good results will be described by example. Part designations refer to the sketch below.



Problem: design an amplifier that will put out 10V peak to peak into a 10 kΩ load. A gain of 5 and an input impedance of 75Ω are required.

Procedure: first pick the supply voltage. Since the output signal is 10V, the supply voltage must be greater than this. Arbitrarily pick 15V.

Second step. In order to adequately drive the load, R_C must be smaller than R_L. Think of the output circuit as a voltage divider made up of R_C and R_L. (Normally the drop across the coupling capacitor will be small) The voltage being divided is V_{CC}. A collector resistor, R_C, of about 1/8th the size of the load resistance will do nicely here. Choose 1.2 KΩ for this example. Needed in the next step is the total collector load, 1.2 KΩ in parallel with 10 KΩ or 1.07 KΩ.

Third, calculate R_e. With a large unbypassed R_e stage gain is very nearly R_{cl}/R_e where R_{cl} is the total resistance the collector sees. This follows from 1, the collector and emitter currents are nearly equal, and 2, the emitter voltage swing nearly equals the base voltage swing. Therefore in the example for a gain of 5 R_e should be 1.07 KΩ/5=214Ω. Use a 220Ω resistor.

Fourth, for maximum output voltage swing, the quiescent (no signal) collector voltage should be about ½($V_{CC}-V_e$) where V_e is the maximum emitter to ground voltage. There is usually no need to calculate the optimum, as a good guess is close enough. In this example pick the quiescent collector voltage to be 8V leaving 7V across R_C. Quiescent collector current is, therefore, 7V/1.2 KΩ = 5.83 mA.

Fifth step. Since the emitter current is about the same as the collector current, the emitter voltage will be about 5.83 mA X 220Ω=1.28V. Adding to this figure the usual 0.7V base to emitter voltage we find that the base must be biased 1.98V above ground.

Sixth step. The input resistance at the base is about beta times R_e for this configuration. In the example a beta of 50 is reasonable, so the input resistance of the circuit will be about 50 X 220Ω or 11 KΩ, but varying widely from transistor to transistor. To swamp out this variation, let the parallel resistance of the bias circuit be 1/10th of this or about 1.1 KΩ. Equations for R_1 and R_2 to simultaneously put out a desired voltage and have a desired parallel resistance are: $R_1=(R \times V_{CC})/V$ $R_2=(R \times V_{CC})/V_{CC}-V)$

Plugging in R=1.1 KΩ, V_{CC}=15V, and V=1.98V yields R_1=8.11 KΩ and R_2=1.27 KΩ. Choose 8.2 KΩ for R_1 and 1.2 KΩ for R_2. To obtain the desired 75Ω input resistance, putting an 82Ω resistor across the input will suffice.

The size of the coupling capacitors will be determined by the desired low frequency response. Note that the calculation for the input capacitor has been made easier by substantially removing changes in the input resistance caused by variations in transistors. Calculating frequency response is an article by itself, but each coupling capacitor causes a roll-off at $F=1/2\pi RC$ Hertz where C is the capacitance in farads and R is the resistance in ohms that the capacitor sees. For example, the output capacitor above sees 10 KΩ plus 1.2 KΩ=11.2 KΩ.

Understanding the above method may appear to be difficult when compared to the cut and try method, but the rewards are greater. With a little practice you should be able to design an amplifier to specifications in less than 10 minutes.

David L. Button
Medway, MA.

REPEATER CONTEST?

A contest through repeaters? How many repeater operators would go along with it?

Repeaters are set up and maintained for extended local coverage of members using mobiles, portables and low power fixed stations. After a contest or two the big guns of contesting would be on with KWs, 64 element arrays and all the other goodies.

Probably very few repeater groups would be satisfied to sit on their hands and pay the light bill for these people to chat among themselves. After a contest or two there would probably be very few machines on the air during contests.

FM operation has grown because it is informal, friendly and you don't need acres of antennas and kilobucks in equipment to operate satisfactorily.

If we must have a contest let's make it once every five years from 00:00 to 00:15 local time with the top thousand scorers in the last contest ineligible to compete in the next.

Don Norman K8LLZ
Elyria OH

You have to be out of your tree to suggest a repeater contest!

Max W5ODF
Little Rock AR

I read your little suggestion (in the current 73) about having a repeater contest. My vote is NO! I knowthat controversy builds circulation,*(1)* and I'm all for your magazine, but please lay off this one. I know that the ARRL is all for lots of stupid contests, but I really thought more of you.*(2)* My thinking? Repeaters are for communications, not competition.*(3)* In areas having numerous repeaters with 50 to 100 watts output, the repeater owners and operators would become egotistic enough to wish to up their power (as a "public service") and help that distant signal many miles away to hear much better. While this goes on in contests, the man who has an emergency on his hands get covered in the general foulup. Without having contests, when skip appears, the distant station works a few through several repeaters and stands by while others work distant stations. Courtesy is the rule, not something exceptional. Let me say here and now, I have never heard any contest on any band where courtesy was present except in nearly microscopic amounts, well hidden in the din. I have quit contests, but I'll listen if you have found some polite ones.*(4)*.

Don Chase WØDKU
Wichita KS

1. To the contrary, controversy cuts down on circulation. You have fallen for a big lie that one or two of the other magazines have perpetuated as an explanation for 73 telling it like

it is. Every time 73 is controversial the circulation takes a dive and ads fade away for awhile. It takes a lot of social conscience to print anything controversial when the reaction is going to be a loss of money. 2. Sorry to disappoint you, but I have always enjoyed contests. I agree that many of them are terrible and I have controversially written just this opinion on many occasions. The reason that 73 has NEVER run a contest is that I have yet to think up a contest that I would be proud to run. This does not mean to me that such a thing is impossible, only that it is difficult. Perhaps you are right and it is impossible to run a good contest. 3. Repeaters are for fun, in any way that is legal. If communications is fun, then let's use them for communications. If "communications" means I shouldn't rag chew, then we need a new definition of communications. If it means no contests then you need to look up the word. 4. I'll go along with that. What do you suggest?

Wayne

A contest is supposed to be a test of operating skill. From your SCR-522 days in Brooklyn and even from operating the powerhouse on 73 Mountain, I am sure you remember a really good operator had to be able to hear signals, find clear spots to call CQ, hear the guy he was trying to work through several other signals, remember which way to point his beam for the rare sections, tune across the stations already worked, and so forth. How can he do these things with strictly crystal controlled operation with omnidirectional antennas? Plus which, on FM you usually hear only the loudest when there are many signals close to the same frequency.

Practically all FM channels and repeaters have been set up to provide a ready means of communication of relatively unimportant first party traffic plus their incidental usefulness for minor emergencies. A general emergency, or substantial message handling, as on the lower frequencies, would create havoc such as used to occur on the "6 meter" MARS channels when E skip would unexpectedly combine 2 or more nets. Widespread contest operation will result in the same thing with not even the repeater frequencies being safe since all the contest station need do is transmit on the repeater output frequency and listen (if he's honest) on the repeater input frequency to get around the rule against repeated signals. Imagine what it will be like when all the guys like me who prefer to leave the FM guys in their own world, are forced by competition to "go FM" to have any chance of ever again winning a contest. If I do, it will be with high power, a big rotatable beam, and crystals for every imaginable frequency.

Finally by your own definition, contesting or FMing or whatever is supposed to be fun. I do not consider it fun to brow-beat a VHF sweepstakes contact exchange out of some guy who just wants to know how to get on Interstate 95, South, nor do I think he gets much pleasure out of it. Those who want to work contest have tunable gear for CW, SSB, etc. in the first place, let them use it.

Terry Banks K3LNZ
Washington DC

Well, Terry, I agree with most of what you say. It has been my experience, though, that FM'ers do seem to enjoy giving a fast contest contact to those mountain-top stations that set up to work them. In point of fact W1DC sets up on top of Pack Monadnock for the ARRL VHF contests and, last year, made nearly as many contacts on 2m using FM as all other modes combined. I heard few gripes. Obviously it could all get badly out of hand.

Wayne

GOOF DEPT.

As an avid reader of 73, I enjoy your magazine immensely and look forward to every copy. I find it very informative in just about every mode of ham radio. However from time to time I do notice errors in some articles, and in most cases, corrections to those errors in later editions.

I would like to point out 1½ errors in your Dec. '71 edition.

Error Number ½ appears on page 19, paragraph 2, where it explains the function of a nand gate. It is stated that "when all inputs are Logic 0, the output is Logic 1." This is a half correct statement. It should read that when *any one* or all of the inputs are Logic 0, the output is Logic 1. I will therefore only credit you with ½ an error. Hi!

The other error appears in the article entitled, "Morse Memory," on page 37. In reference to Fig. 6 on page 44, it shows that the outputs (pins 10 through 13) of A11 and A12 are connected to the inputs (pins 1 through 6 and 11 and 12) of A7.

However, in Fig. 2, page 41, A7 identifies a memory device, and the gate that A11 and A12 are fed into is unidentified. This caused some confusion when trying to follow the circuit when relating to Fig. 6.

Perhaps a correction will clear this up for readers that are confused, or am I the only one? Both articles, however, even with the 1½ errors total, still rate an A+. Would like to see an article on the Hal Devices Teletype CRT Readout Device or whatever they call it. How about it?

Al Bratz WA8YNH
Dayton OH

We made those errors just to test you, Al. Can any of our readers tell us more about the HAL machine?

BOUQUETS

I ordered the 30 back issues of 73 for $6 I found advertised in the June issue of 73. I've been QRT for three years and I used them to ease me back into ham radio. They were DYNAMITE! 73 is much better than ** and I won't even mention that funny "street" magazine.

John Phillipp WB2HYI
Brooklyn NY

On page 2 of the November issue, it is asked if any readers have run across the number 73 anywhere interesting.

I am a radio operator in the Canadian Armed Forces serving in the Submarine Service. Halifax is the home-port of the three submarines serving on the Canadian East Coast. One of them, the "Onondaga," bears the number "73" on its hull. I am sending a picture of it taken when the submarine was on the synchrolift.

The other two submarines are the "Okanagan" (74) and the "Ojibwa" (72). Since I volunteered for submarine service I served on all three of them. The Okanagan is the only one with an amateur station license at the present. The call is VEØNS and is being operated by Bob Forbes VE1AAU and Jim Guilford VE1ANO. I am now serving on the Ojibwa and she might be getting a station license in the near future, so I'm looking forward to operating VEØ .

When the submarine goes deep during a QSO, I have to QRT and close down. There isn't much I can do down there except to sit back and read a few back issues of 73. So, if you stand by, I will QRX when the submarine goes back up to the surface.

Do you believe in love at first sight? I didn't until I looked at the front cover of the November issue. I got a few centerfolds of Playboy hanging on the radio shack walls but I think I will replace them with the January, March, April and November front covers of 73. Keep making the same type of covers and I might become a life subscriber to your excellent magazine.

Donald J. Courcy VE1AKM
Halifax NS Canada

Much thanks for the new format. No more swinging mag to read. Now try a little larger print on the newspages even if you sacrifice some of the "Slum Gullion."

Lee J. Delworth WB6RDW
Anaheim CA.

Do not exactly know if you want a letter from a simple SWL or not – but I do so much enjoy the letters in your magazine that I want to say a word or so.

Now, my good friend WB6DGJ – (darn Good Jim) Myers has urged me and done his best to get me to get a license – learn the code and so forth, that I am ashamed of myself for not doing that. Jim is too good a friend to tell me that I'm just too lazy, but it's a fact.

Let's go way back to 1920 – that is when I first got interested in electronics, or wireless as it was in those days. I was born with a strong desire to become an electrician, and of course the urge, augmented by a magazine

:alled the 'Electrical Experimenter' ielped to push me along. In those lays, a WD11 was quite the thing, also he UN199. My friends were anxious o have a wireless set to listen to KDKA in Pittsburg, and the other tations who came along, slowly, SO, I built sets for them, and today, a friend of mine in Grandview, Washington has put one of my old sets in a nuseum there – haven't seen it yet, but I'm sure it is authentic, with the old horn speaker and the breadboard chassis with a hunk of Bakelite for a panel!!

Today – Pity is: I have an SB31 0 hat I built myself (bless Heathkit!). It gives me much pleasure – the hams but in the Pacific in the Micronesian net make me drool each night after I get home from managing the biggest theatre in Northern California. The shortwave stations from all over the world come booming in, and I try to ell myself that I am happy, yet knowing that if I ONLY had the guts o sit still long enuf to learn the code, 'd be one of them.

Your magazine is the best of the bunch – which of course you know. Old 'Never Say Die' is a good editor! I only wish I could contribute an article worth reading.

Art Warner
P.O. Box 2511
McKinleyville CA 95521

Will someone PLEASE help Art to get his ticket!

Congratulations on the publication of the 135th issue of 73 Magazine! Along with Ralph Nader and Wally Hickel, we have you providing reading material for hams with an IQ above 100. Fortunate for us . . .

Your editorial covers "meaningful" contacts quite well; that is a major problem and perhaps one reason why so many of us have long periods of inactivity, or, limit our contacts to a few friends around the country/world primarily.

As to phone patches, I think that is one area where the hobby fulfills the public interest area of licensing amateurs or other radio services. Especially, the patches for overseas military personnel.

There certainly does seem to be a "Vast Wasteland" out there . . . Best wishes to you and yours for a happy holiday season and a successful 1972.

Harlan D. Marcus W5MDT
Dallas TX

Have had tremendous response from advertisers I requested info from. Your consolidated request form for advertisers is a real winner!

John Andrews WB5ETV
APO, NY

I'm currently in the Marine Corps, unfortunately being hospitalized in the U.S. Naval Hospital Camp Lejeune NC. I just got back from the Far East and am a little behind in my reading. However I just completed your Oct. '71 issue and must say that your article written by John Campbell W2ZGY "How to be an Amateur," is one of the most inspiring and motivating articles yet. Bravo – it was well written. I enjoy 73 Magazine much more than its competitors which I also subscribe to. Each is good, but your variety of topics and contemporary technical articles have made your magazine worth more than the price on the front cover. I even look forward to the front cover for its art. The entire October issue is marvelous, the articles by Jim Ashe W1EZT, Bob Cooper W5KNT, H.P. Fischer VE3GSP, W. W. Davey W7CJB and others in the October issue and hundreds of amateurs like them in each of your issues has greatly added to the success of your (OUR) magazine. I'm finding myself addicted to 73 and I greatly enjoy the high! Congratulations on a job well done.

Thomas E. Mills WB4UBA
Jacksonville NC

Caveat Emptor?

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ROCHESTER, N.Y. is again Hamfest, VHF meet and flea market headquarters for the largest event in the northeast, May 13th. Write WNY Hamfest, Box 1388, Rochester, N.Y. 14603.

DRAKE R4: Excellent condition. Previously owned and aligned by Clegg at Squires-Sanders. $273 or best offer. John Bradley, 321 North Fullerton, Montclair NJ 07042.

FCC "TESTS-ANSWERS" . . . Original exam manual for First and Second Class License. –plus– "Self-Study Ability Test." Proven! $9.95. Satisfaction Guaranteed. Command, Box 26348-S, San Francisco 94126.

21st ANNUAL DAYTON HAMVENTION will be held on April 22, 1972 at Wampler's Dayton Hara Arena. Technical sessions, Exhibits, Hidden transmitter hunt, Flea market and special program for the XYL. For information write Dayton Hamvention, Dept. 7, Box 44, Dayton, OH 45401.

ELEPHANT hide Leather. Keycase $2; Billfold $7; Pocket Notecase $10. All three – only $15. Beautiful gifts. Money back if not satisfied. Write ZE7JV, P.O. Box 23, Cranborne, Rhodesia.

REGENCY, GALAXY, Hy-Gain, Rohn, SBE, Hallicrafters, Hammarlund, Barker and Williamson, CAI, Scientific Radio Systems, Simpson, Dycomm, Gladding, Harman-Kardon, Midland, Scott, Sherwood, Altec, Ampex, RCA, GE, Zenith, Kodak, Polaroid, Bell-Howell, Argus, GAF, Pentax, Gruen, Lucien Piccard, Jules Jurgensen. Write Steven Kullmer, Evergreen Inc., Dysart, Iowa 52224.

2M FM, 50W, Motorola 53 GJV, two with accessories, tuned on 146 mHz, one with no xtals $100. Other with 34–94, 85–85, 94–94, 82–70, $150. W6DZO, 1021 West Cedar Ave., Redlands, CA 92373.

NU SIGMA ALPHA International Radio Fraternity. Look to Advertisers Index for space ad.

SALE OR TRADE Tektronix 531A; Gertsch FM-3 Freqmeter Panadapter IP-173A/U. Interested in SSB Transceiver. Tilleman, K5IDD 351 Furr, San Antonio, TX 78201.

MOTOROLA P33AAM 2-meters "Handi-Talkie," 5-watt portable. Exceptionally clean. Club lot buy allows low $75 price. Complete less antenna, batteries. Gordon, 25 Norma Ave., Lincroft NJ 07738.

MOTOROLA T44A6 450 MHz. TX: 2 Freq. RX: 2 Freq - Sensicon Front end. Original manual, cables, speaker. New Motorola TCN 600 control head. Clean. $50.00. J. A. Smith, Box 2065 Newburgh NY 12550. Tel 914-562-4300.

ALMOST FREE. Taped code lessons. Beginners to 5 wpm. Refundable deposit on tapes, $1.00 for postage. Tomlinson College Radio Club, 3637 West Grandview, Tacoma, Wash. 98466.

TOLEDO MOBILE RADIO ASSOCIATION's 17th annual hamfest and auction will be held Feb. 20, 1972 at the Lucas County Recreation Center, Maumee, Ohio. $1.00 registration, open table sales. For map and info write TMRA W8HHF, Box 273, Toledo OH 43601.

STANDARD 816M like new condition with original box and manual, TX crystals 146.82-22-25-34-94-76. RX crystals 146.22-88-82-76-94. Cost new 6 months ago $370.00, first $240.00 takes it. Bill Thorpe WA1NLR, P.O. Box 306, Southboro, Mass. 01772.

Peter Lovelock W6AJZ
235 Montana Avenue
Santa Monica CA 90403

TUNING Mr. MORSE'S KEY

Since every license holder has at some time done a stint of key walloping, it might be assumed that we are all completely familiar with the beast. In fact, a recent study of some of the most comprehensive books dedicated to our hobby revealed almost nothing concerning the care and feeding of the key.

However, an evening spent listening on the CW bands will prove that the 'glass arm' is still with us, indicating that the selection, adjustment and operation of the familiar key may have well become neglected among all the other technological advances. If you are a regular habitant of the CW bands, or perhaps a member of a high speed traffic net – read no further. But if you are a Novice, or an oldtimer getting reestablished on the key, some of the following may be helpful

The humble telegrapher's key has gone through an evolution emerging in many forms some of which have already become obsolete. Today the three basic types found in ham shacks are the straight or "manual" key; the "bug" or semiautomatic key; and the electronic key.

Straight Keys

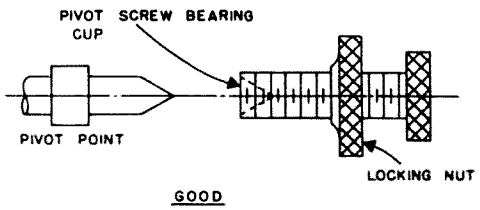
The popular American key is most generally used by hams for manual operation, and permits the greatest ease of operation. The pump-handle key, beloved by European and some oldtime Navy operators has all but disappeared. The former is characterized by wrist operation, while the latter, mounted at table edge, was arm operated. So if you have one of these relics from some surplus buy, keep it as a conversation piece or donate it to the Smithsonian.

If you are in the market for buying a straight key, invest wisely and buy the best available. Many of the inexpensive varieties, available for a buck or two, may be fine for Boy Scouts to earn their badge, but will not guarantee lasting satisfaction.

The essential requirements of a good key are first quality material and construction, including friction-free pivot bearings, low resistance corrosion proof contacts, smoothly adjustable return springs, and well designed balance. There are a number of manufacturers that have been producing such keys for generations, and their products are well worth the cost (upwards of $10).

If you have on hand a good key, it is worth a little time to make sure it is correctly adjusted. Even if the key is brand new, contact spacing and spring tension will have to be set to suit your fist. Disassemble the whole thing, being careful to note how the bits and pieces have to be reassembled, and give everything a good cleaning. Use metal polish to brighten up

the base and arm. If yours has a black crackle paint base, an old toothbrush and a little detergent in warm water will get rid of the dusty appearance. Examine the pivot points on the arm to make sure they are smooth and undamaged and that previous overtightening hasn't deformed the points or the cups in the bearing screws. See Fig. 1. A jeweler glass or one of those hand microscopes for inspecting phono pickup styli is handy for this examination. Check the contacts, and if they appear dark and oxidized, a few *light* strokes with a burnishing tool (Walsco type W529 or equivalent) will put them in shape. Do *not* use a file, even of the spark plug cleaning variety.



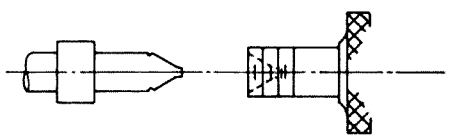
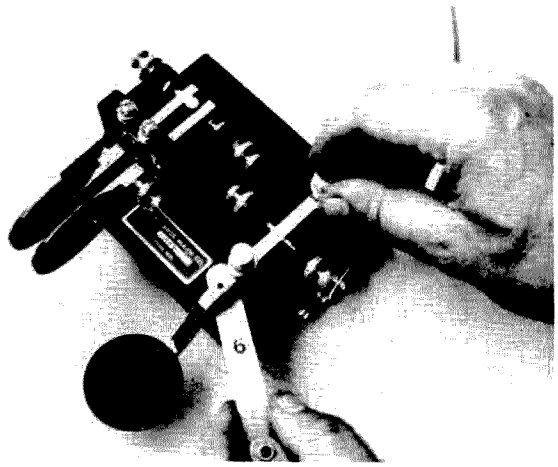


Fig. 1. Key adjustment.

Reassemble the arm, pivot screws and spring loosely, adjusting each of the pivot screws until the contacts are centered. *Very gently* turn both pivot screws clockwise, until you feel the pivot points just bottom in the cups. Do not tighten further or the points may be damaged. Tighten the locking nut on one pivot screw, while holding the screw stationary. Back off the other pivot screw about 1/10th of a turn and similarly tighten its locking nut.

Now adjust the rear stop screw for proper contact spacing. What is proper is largely dependent upon your fist and speed of operation. Slower speed, larger spacing, and vice versa. About 0.005 in. has been found appropriate for moderate to higher speeds, but if you are a slow sender you may find as much as 1/16 in. desirable. Using a feeler gage to measure the contact spacing best suited to you is a good idea. You can then always quickly reset the spacing after some future disassembly. Just remember that too wide spacing will limit speed, while too close spacing may affect the intervals between characters.



Adjusting manual key contact spacing with feeler gauge.

Finally adjust the spring tension to your liking. A good method is to send a series of dits at a comfortable speed, while slowly advancing the tension screw clockwise. You will find a point where the spring tension counterbalances wrist movement, and the arm returns easily without requiring excessive depressing action. At this point the string of dits should be almost effortless. As with contact spacing, so with spring tension, and some final compromise between both may be necessary after a little operating experience. Too strong a spring tension will result in rapid overtiring of the wrist and forearm muscles, while too light tension will require lifting the wrist, and eventual stumbling over characters.

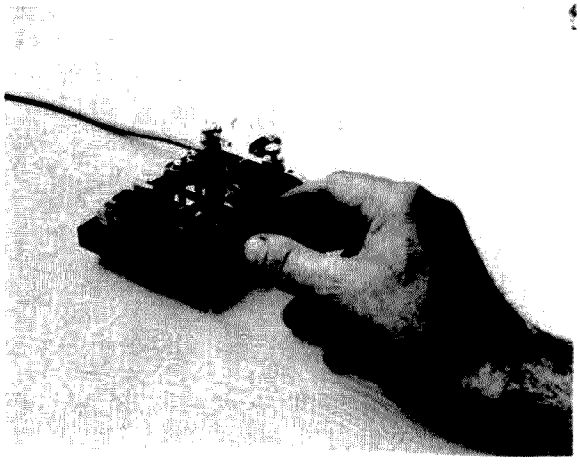
No dissertation would be complete without a few words on proper operation. First, the key must be mounted on a heavy base that won't slide around, if not actually screwed to the operating table. If yours is mounted on a base with rubber feet and it still tends to "walk" across the table, try rubbing a little beeswax on the rubber feet.

The key should be positioned on the table so that the entire forarm can lie comfortably on the operating surface. If

your table is too narrow, try sitting sideways to the table to properly position the arm, which under no circumstances should have the elbow or part of the forearm hanging over the table edge.

Semiautomatic Keys

The venerable "bug" key has long been the favorite of the higher speed operator, particularly for use in excess of 18–20 wpm. It hardly seems necessary to mention that no one who cannot send 20 wpm on a straight key should attempt operating with a bug. However, there are some who apparently feel that such an endeavor will help to increase the speed they cannot accomplish on the straight key. Nothing is further from the truth. Most bugs have mechanical dit speed adjustments which are difficult to set below the equivalent of 15 wpm. The characteristic result of sending 10–12 wpm, is complete unbalance in the dit-to-dah ratio, which can be pretty unintelligible to the fellow at the receiving end.



Correct grasp for manual key.

The bug employs a vibrating spring attached to the horizontally moving arm, to produce a series of dits when the paddle is depressed to the right by the operator's thumb. Dahs are made manually be depressing the paddle to the right with the second and third finger, as with the straight key.

All the factors previously stated about selection, inspection and maintenance of a straight key apply equally to the bug. A good quality bug costs from $19 to $30 (more if you like to dress up your shack with a little gold plating).

If you are reactivating your old bug, or have obtained a second hand one, submit it to the same kind of disassembly, inspection and cleaning recommended for the straight key. Be extra careful to take note of how the pieces come apart, particularly with regard to insulating bushings, washers and springs, which can take on the aspect of a Chinese puzzle come reassembly time. Keep small parts in a plastic tray.

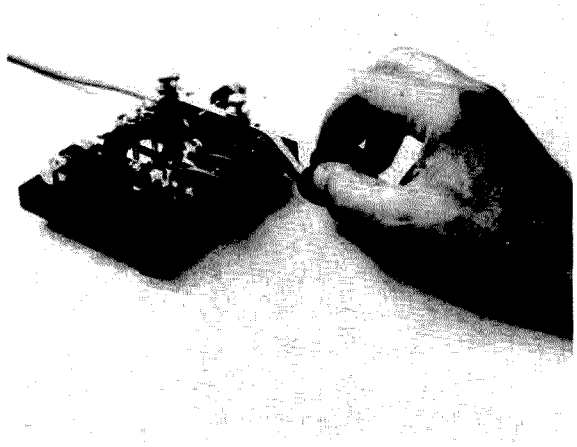
The tricky part is adjusting the paddle movement and contact spacing. Start first with the dit action, and adjust the left stop screw for the amount of dit-paddle depression you feel suitable. Just what is suitable is again individual, but bear in mind that too much will affect speed, while too little will give trouble with correct spacing. Some correction is likely to be required later.

Now adjust the right stop screw for an equal amount of travel of the dah paddle. Once you have the right-left paddle movement adjusted, tighten the lock nuts.

To adjust the dit contact spacing, first hook up a code practice oscillator or ohmmeter to the key terminals. With the dit paddle fully depressed, wait for the armspring to stop vibrating and become completely motionless. Then slowly adjust the dit contact screw until it just makes electrical connection with the spring contact, as evidenced by the oscillator or ohmmeter. Carefully tighten the locking nut without changing the screw setting.

Now try out a string of dots with the oscillator, having set the spring weights for slowest speed. The dits should sound about equal to their intervening spaces. If the dits sound clipped with overlong spaces, advance the stationary contact screw about 1/8th of a turn, and repeat this until the dit-space ratio is right. If your shack sports a scope, it can be a great help in observing the correct ratio by setting the horizontal scan rate to a slow sweep. Likewise, if the dits are overlong, and sound blurry, retract the contact screw 1/8th turn at a time until proper ratio is achieved.

Since the dah stop is usually also the dah contact on most bugs, initial adjustment has now been completed. And small



Correct grasp for electronic or bug key paddles.

adjustments of paddle travel and contact spacing, with intervening periods of operation are better than making wild changes that cause you to lose track of where you started from. Also, if you change the dit-paddle travel, it will also be necessary to reset the dit contact spacing..

Adjusting the left and right paddle return springs can be a bit tricky in models that have two such springs, but basically the same rules apply as for the straight key. Just enough tension to return the paddle snappily without requiring excess effort to depress the paddles.

After setting the bug to your liking, adjust the speed weight(s) for a dit speed equivalent to your comfortable operation. Then try sending a series of PARIS and ISH5. Just remember that a dah is equal to two dits with one intervening space (or three dits with no spaces), and only your manual skill can apply the correct ratio dahs to the mechanically produced dits.

Electronic Keys

Nothing has done more for effortless high-speed operation than the advent of the electronic key. While the same rules apply to perfecting straight key operation, advancement to the electronic key may be easier than to the mechanical bug. This is because many models can be set for as slow as 10 wpm and are less dependent upon operating skill for correct character ratio.

Early models took considerable skill, since completion of each dit and dah was dependent upon the operator holding the contact closed for the proper period, and early release would clip the character. Contemporary keyers all have self-completing features that insure that a full dit or dah is completed once the contact is closed.

Since the electronic key comprises two basic parts, the mechanical paddle and the associated electronic circuitry, the two will be considered separately. In many instances the two are packaged separately, and connected by an intervening cable, but in some recent commercial models the paddle movement is built-in to the electronic unit, such as in the Heathkit Model HD-10.

The mechanical paddle used with an electronic keyer closely resembles the bug, but lacks the dit-producing spring movement, and has instead a second pair of stationary but adjustable contacts to activate the electronic circuitry. This type of key itself breaks down into two basic types, depending upon the type of circuitry it is intended for use with. The simplest type has a single moving arm, like the bug, mounted on a pair of pivots. A more complex version has two independently pivoted arms, with individual paddles mounted close together, each being capable of simultaneous movement. The latter type of key is used with electronic keyers that automatically generate dits when the left paddle contact is closed and dahs when the right paddle contact is closed. The twin arm key can also be used with this type of circuitry, but is really intended for use with more elaborate electronic keyers that produce alternating dits and dahs when both pairs of contacts are closed by squeezing the paddles between thumb and fingers. This is known popularly as squeeze-keying, and reduces wrist movements required for sending given characters.

As for example: the letter C requires four independent wrist movements, one dah, one dit, one dah and one dit. With squeeze keying the right paddle is depressed for the first dah, and then held while the left paddle is depressed, so that both paddles are squeezed, producing the dit-dah-dit portion of the letter. Thus only two paddle movements are required for the

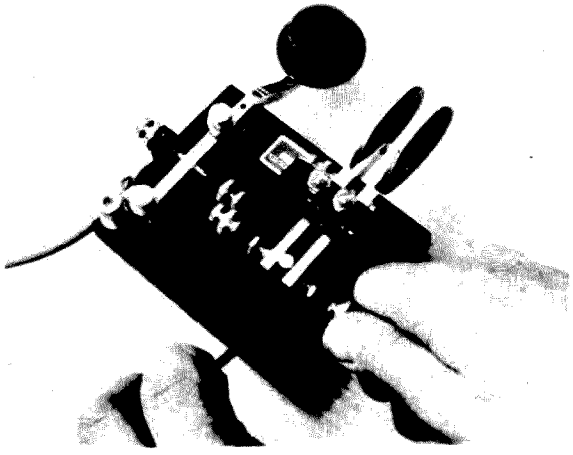
letter C, instead of four with the simpler electronic key. Note also that this requires independent finger movement, rather than straight wrist action.

Apart from the independent arms of the squeeze-type key, mechanical assemblies are otherwise the same, and previous recommendations for inspection, cleaning and adjustment of pivots apply. However, one further adjustment is worth noting – that of equal contact spacing and paddle travel in both directions.

There are a number of electronic type paddle-keys available on the market, costing from $15 to $20, independent of the electronic keyer.

Now to consider the electronic keyer itself – the circuitry part which produces those flawless dits and dahs. Here the problem is somewhat more complex with the different features offered.

Early keyers provided individual controls for speed, ratio, and weighting adjustments. This may seem nice, but getting ratio and weighting just right can be tricky. Moreover, some circuits require resetting ratio and weighting whenever a major change in speed is made – obviously a disadvantage. Logic circuitry used in late units permits inclusion of a single control for speed, with ratio and weighting always being perfect whatever speed is selected. Ony excellent version of this type which you can build yourself is the Micro-TO Keyer by K3CUW (QST, August 1967 and ARRL Handbook 1968).



Adjusting electronic key contact spacing with feeler gauge.

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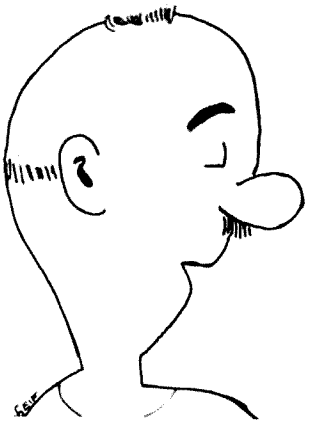
Other features include optional full automatic, or semi-automatic (auto-dits, manual dahs as in the bug); built-in sidetone oscillators and speakers; and built-in paddle mechanisms. Many keyers utilize a high speed relay as the output to key the transmitter. Reed relays are commonly used to accommodate speed requirements, but their contact ratings are limited and may not be suitable for directly keying some transmitters (such as cathode keying a high power stage). Other units use a power transistor to perform the keying function, and these avoid contact sticking, and have absolutely no time delay. On the other hand correct polarity has to be observed, as does the maximum current handling capability of the transistor used. All manufacturers specify such constraints in their instructions so take care when buying to select one compatible with your transmitter. Selection of any commercial unit will depend upon the features most desired by the individual after a careful perusal of the manufacturer's specifications.

So whether for you it's manual, semi-automatic, or fully electronic – happy keying!

. . .W6AJZ■

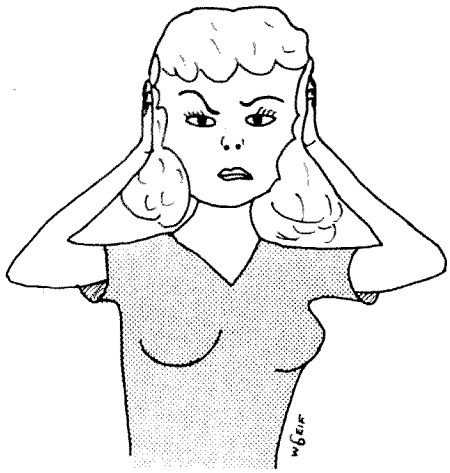
CW as seen by. . .

THE EXTRA CLASS

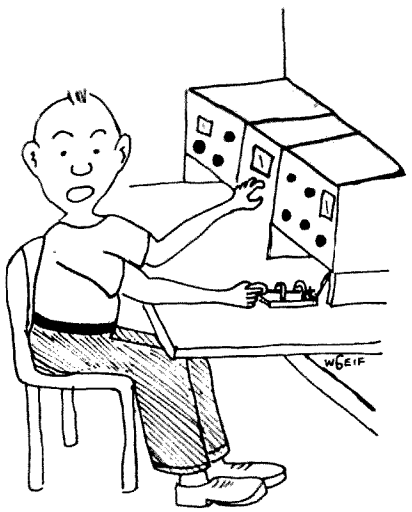


"Nothing to it!"

THE XYL



THE DX'ER



First we send "DE," then our own calls.

THE RTTY MAN



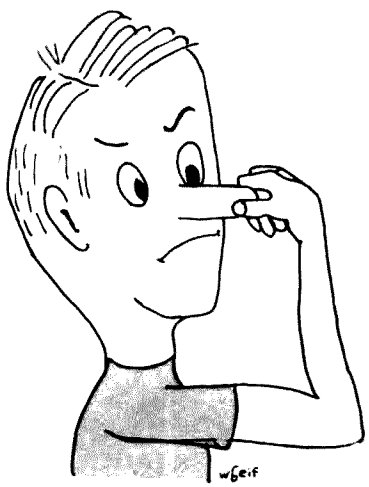
"How do you get 26 characters from only ONE key?"

THE CW MAN



"The ONLY way to fly!"

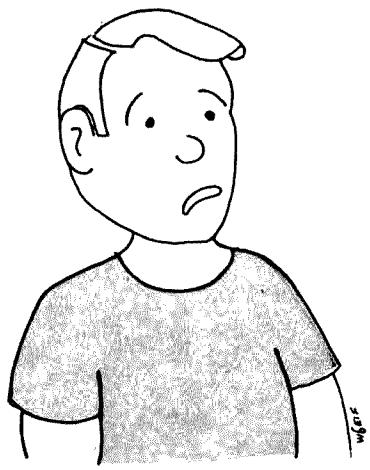
THE ADVANCED CLASS





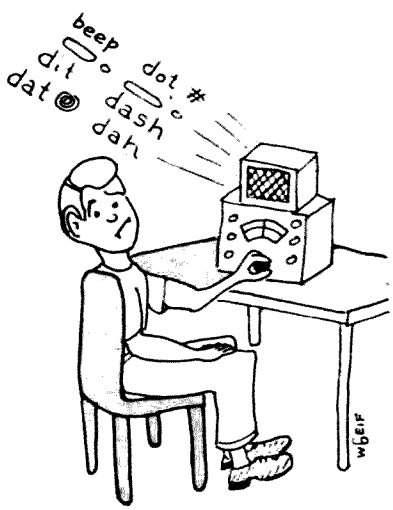
Wayne Green's view of a typical CW operator.

THE NOVICE

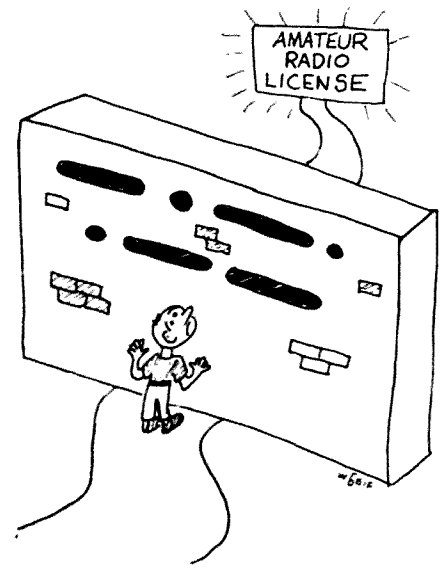


"What else is there?"

THE SWL



THE WOULD-BE HAM



THE TECHNICIAN



THE CB'ER



"See double you?"

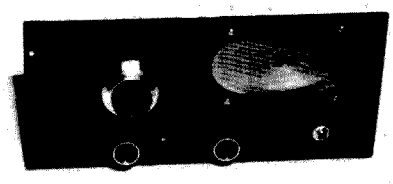
Sam Kelly W6JTT
12811 Owen Street
Garden Grove CA 92641

A Solid State High Frequency Regenerative Receiver

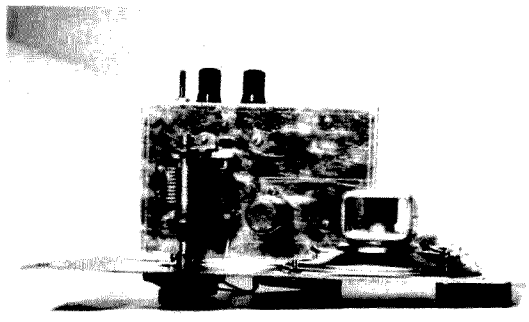
Like most hams, the first receiver I built was a one tube regenerative detector. Recently, while thinking back over old times, I decided to try my hand at building a solid state regenerative receiver just to see what kind of performance I could get. While the circuit shown has a few more components than my first receiver with its type 30 tube, it performs much better.

The receiver tunes from 14 to 35 MHz, a range that covers three ham bands, short wave stations and public service frequencies. The detector uses the readily available Motorola HEP 55 NPN VHF rf transistor. The audio amplifier stages are a single RCA 3020 linear integrated circuit. This is an entertainment grade IC and is quite a bargain.

The receiver was built on a 4 x 6 x 2 in.



The solid state high frequency regenerative receiver. A 3 x 5 in. speaker was used. The dial assembly is a Japanese import having a 10:1 ratio.



Top view of the receiver. Note the location of the transistor socket next to the tuning capacitor.

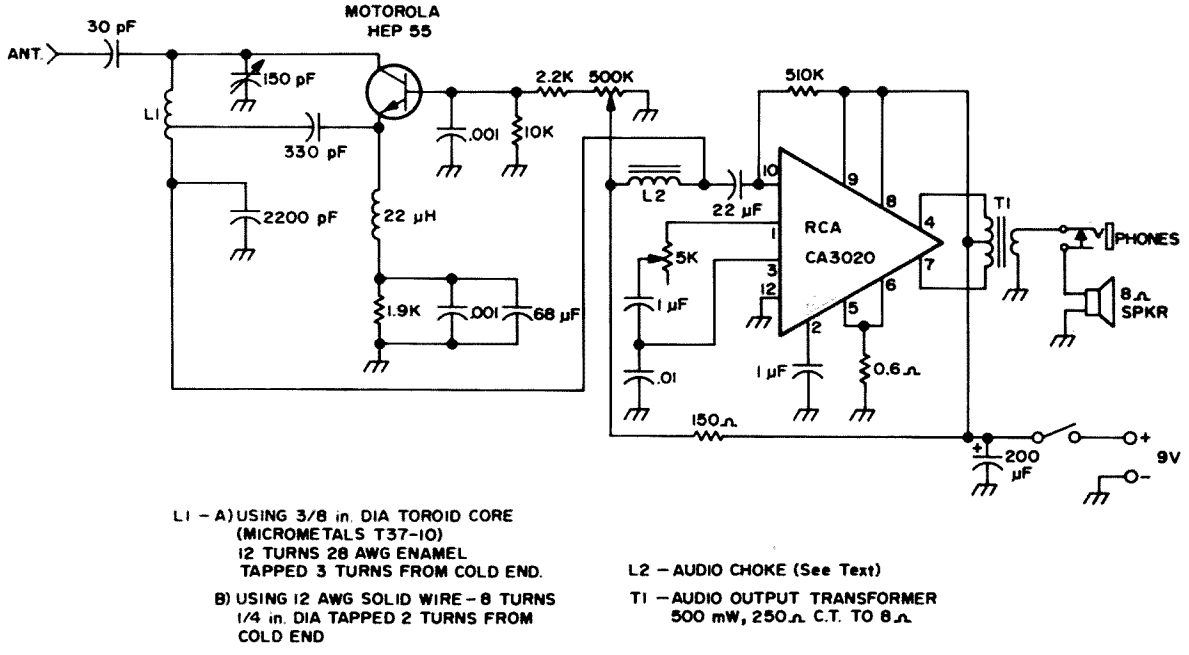


Fig. 1. Schematic of the regenerative receiver. L-1 A) using 3/8 in. toroid core (Micrometals T37-10) 12 turns #28 enamel tapped 3 turns from cold end; B) using #12 solid wire 8 turns ¼ in. diameter tapped 2 turns from cold end; L-2 audio choke (see text); T-1 audio output transformer 500 mW 250Ω CT to 8Ω

aluminum chassis. The audio circuitry, with the exception of the audio choke, was mounted on a 2 x 3 in. piece of vectorboard. The vectorboard was mounted to the chassis on threaded stand-offs. The input audio choke L2, is just the primary of a small 100K to 95K audio transformer. The secondary is not used. Practically any small audio transformer having an impedance in one winding of from 10 to 100K can be used. An alternate approach is to use transformer coupling with a small 20K to 50K interstage transformer.

All of the rf components except the tuning capacitor, are mounted below chassis. A transistor socket was used to permit experimentation with a variety of transistors. Actually a socket is a good idea unless you have had some experience in soldering to semiconductor leads.

You will notice that winding information is given for two different types of coils. The best bet is to use the small toroid cores which are carried by most major parts houses for about 10¢ each. If your local parts house doesn't carry them, use the alternate method. There isn't much difference in performance.

After wiring the circuit, carefully recheck your work. Remember, transistors, unlike tubes, are not forgiving about wiring errors. Now you are ready to hook up the antenna and apply power. Your best bet is to buy a battery holder that holds six D cells. While the idling current of the receiver is only 23 mA, peak currents are in the order to 50–60 mA. The cheap 9V transistor radio batteries aren't designed for this kind of use. Their internal resistance is quite high, and you will probably experience motor boating after short periods of use. The premium grade 9V batteries perform well, but their cost is high.

Connect the antenna. A 40 to 50 ft wire works well. Turn on the power and advance the regeneration control until a clean hiss is heard. Tune in a signal and alternately adjust the tuning and regeneration controls for best reception. A little practice will give you the knack of it.

Performance of this little receiver has been quite good. I have received signals from all over the world, not to mention the fun of listening to the local sheriff's department. Regenerative receivers aren't to be scoffed at for communications, either. I recently worked a station in Colorado (about 1200 miles) who was running five watts and receiving me on a regenerative receiver!

. . .W6JTT

Wm. G. Welsh W6DDB
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Burbank CA 91504

HEADSETS and HAM RADIO



There are several advantages to be gained by using a good pair of earphones in an amateur radio station. I hope this article will convince a few more hams to plug in their headsets and to cut out their loudspeakers.

Most hams operate from their homes and their stations are often set up close to where others are conducting activities completely unrelated to hamming. Using a good headset isolates us from most of the noises which might otherwise distract us from attentive listening. It is much more important, however, to realize that even the rarest DX is just so much objeetionable noise to those not interested in amateur radio.

You effectively double the power of the received signal when you switch from loudspeaker listening to using a pair of earphones. When copying weak code or voice signals, use of a headset can make the difference between whether or not you can enjoy a solid contact – or even complete the contact at all!

It is important to use earphones with good earmuffs. Earmuffs keep distracting external noises out and trap the desired acoustic energy where it will be applied to the hearing system. Old earmuffs get worn and they become rigid. The rigidity is mainly due to the effects of the earmuffs repeatedly becoming soaked in perspiration. When earmuffs deteriorate, they cause a loss in the high-frequency response characteristic of the earphones. Also, some of the desired signal leaks out and undesired noise leaks in past worn and rigid earmuffs. It is important to have thick earmuffs which are very flexible. Earphone efficiency is reduced if the headband does not exert enough pressure to hold the earmuffs firmly in place over both ears. Do not use a headset which exerts too much pressure, because it will be uncomfortable. Some headsets are actually painful when they are worn more than an hour.

The more powerful earphones provide improved performance, but they are larger and heavier. The increased size is usually not objectionable but heavy headsets are uncomfortable when they are worn for a long time.

We will not all agree that the same headset provides optimum sensitivity, earmuff pressure, noise protection, weight, and comfort. If you can do so, borrow several different types of headsets from your friends and run your own comparison tests to determine which set suits you best. There are several excellent military and commercial headsets available.

As delivered, both earphones are connected in phase in a headset. When listening to an extremely weak signal buried in noise, readability can be improved about 30% by just reversing the leads attached to either earphone in your headset. The human hearing system automatically cancels noise which is presented out of phase to both ears. The preferred (out of phase) connections can be

determined by noting which connection arrangement provides the best reception of an extremely weak signal on a very noisy band. I simply installed a double-pole, double-throw rocker switch at my right earphone to permit me to change the phase of signals applied to one ear immediately; this allowed others to hear the results of the phase shift also.It is almost impossible to note any difference when listening to a strong signal or when listening to a signal on a quiet band.

If you are working a very noisy band, you can effectively mask out most of the noise by wearing a fitted pair of earplugs under your earphones. The signals will seem to filter through the earplugs remarkably well, while most of the noise will seem to disappear. If you use earplugs or transducer-type earphones, it is wise to have them fitted to your ears. An incorrect fit causes discomfort and inefficiency. The transducer-type (air column) earphones are not a good choice in any situation where several people use the same headset.

If you delay the input to one of your two earphones about 500 microseconds behind the input to your other earphone, you will realize about a 5% increase in the intelligibility of a weak signal on a noisy band.

A pair of earphones is preferable to a single earphone in a headset. Human hearing tends to cancel out noise which is presented equally to both ears. When using a dual-earphones headset, we can detect signals which are 2–3 dB lower than the signals we can hear using a single-earphone headset. Most people do not have equally good hearing in both ears. At one kHz the better ear is normally about 2 dB more sensitive and it is usually about 6 dB better at 10 kHz. Once we reach about age 25, our hearing starts to deteriorate. Our high-frequency hearing capability decreases much faster than our ability to hear low frequencies. Men usually suffer about twice as much hearing loss as women during their lifespan.

If you can apply noise out of phase to both earphones while you just apply the desired signal to one earphone, the signal will completely dominate your hearing and the noise will seem to disappear. When performing this experiment in a laboratory, the signal actually seemed to be coming from inside the head, whereas the noise sounded external and was easily ignored.

If noise is applied out of phase to both earphones – while signal is applied in phase to both earphones– signal detection capability is greatly increased. Again, this is more of a laboratory experiment than a real life arrangement.

High audio levels cause human hearing to suffer a loss called temporary threshold shift (TTS). TTS amounts to a built-in gain control which reduces the hearing level when one is subjected to loud sounds. TTS lasts from a few seconds to several hours, depending on the intensity and duration of the sound which originally caused this temporary hard of hearing condition to exist. Get in the habit of turning the gain down to the lowest point at which you can comfortably copy the signals you want. As a general rule, you will find that noise and interference are minimized by running your audio gain almost wide open and turning your radio frequency gain down to the point where you are just barely able to copy the signals you want. If you are working code, don't make the mistake of adjusting your beat frequency oscillator control to the point where you produce a pleasant low musical tone. If you're trying to listen to a signal buried in noise and other signals, it is much easier to pick out a higher pitch which is slightly objectionable.

Use a headset with an input impedance that matches the output impedance presented at the headphones jack of your receiver. Mismatched impedances cause power loss and distortion of the audio output signal. Many receivers are subject to damage of the audio output stage if they are operated without an output load such as a loudspeaker or headset. It is wise to leave a loudspeaker or a matching load resistor across the loudspeaker terminals to protect your receiver from damage which could occur when the headset plug is disconnected, or if the headset opens up.

Do not use high-fidelity earphones in your station. Headsets with wide-frequency-range characteristics just reproduce added interference which reduces communication capability. You should use communication–

type earphones with their limited-frequency -response characteristics. Effective communications can be conducted using an audio range of 400 to 400 Hz, or less. Generally the available headsets have a wider frequency response than is desired, but several come close to filling our needs.

In summary, headsets offer many advantages over loudspeakers. Nevertheless, hams frequently struggle through unsatisfactory contacts due to their use of loudspeakers. More important than the loss of communication capability is the simple fact that the use of loudspeakers makes amateur radio station operation disagreeable to other members of the ham's household. If you don't have a good headset, I am sure your family would be glad to buy one for you – providing you'll promise not to use that damned loudspeaker!

. . .W6DDB

The following references provide excellent additional details and contain many references to other sources of information on this subject:

1. Aerospace Medicine, Volume 41, Issue #7 of July 1970. *"Auditory Processing for Speech Intelligibility,"* by J. T. Tobias.
2. COMFAIRWINGSLANT, Avionics Branch of the Logistics Division, Personal Communication of September 1970.
3. Human Factors Research, Inc. of Los Angeles CA. Technical Report 1 (AD-237-691), *Human Factor Problems in Antisubmarine Warfare: Review and Critique of the Literature of Vigilance Performance,"* by J. J. McGrath, A. Harabedian, and D. N. Buckner (1959 Report).
4. Human Factors Research, Inc. of Los Angeles CA, *"Human Factor Problems in Antisubmarine Warfare : Notes on Some Human Factors Problems in Fixed-Wing ASW,"* by C. H. Baker (1962 Report).
5. McGraw-Hill Book Company, Inc. of N.Y., *"Human Engineering Guide to Equipment Design,"* By C. T. Morgan, J. S. Cook, A. Chapanis, and M. W. Lund (1963).
6. Naval Aerospace Medical Institute Letter. Serial Number 354/CT-3990 to Naval Air Systems Command, Dated 9 November 1964. *"Evaluation of Telephonics Headset Type H-178."*
7. U.S. Atlantic Fleet Letter, serial number 332B/0415, dated 16 October 1957 (AD-385-363). *"Human Factors in Airborne Antisubmarine Warfare Acoustical Systems,"* by R. P. Jeanneret and C. J. Theisen.
8. U.S. Medical Research Laboratory, New London CT Memorandum Report 57-5, *"The Most Efficient Use of Ears in Submarine Sonar,"* by J. D. Harris (1957).

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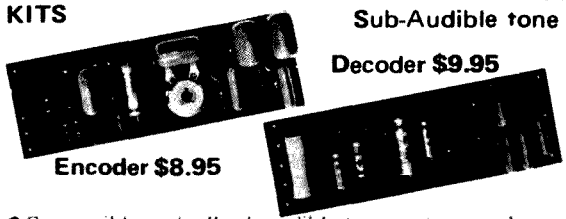
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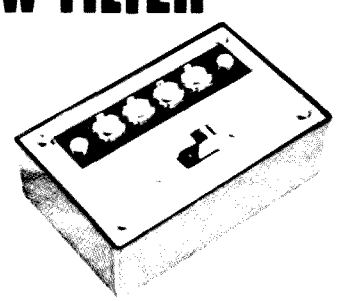


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THE PERFECT CW SIGNAL

Rereading a bunch of old 73's recently, I came across an article by W3RMI on page 30 of the August, 1967 issue, "Visual Monitoring of Remote Carriers", subtitled: "What does your CW signal look like?" That set my mental gears rolling. What could a fellow do, I wondered, to get the best possible keying characteristics for his CW rig?

After thinking it over for a while, the problem resolved itself down to one question: What circuit could start and stop a sine wave (your carrier) without introducing any discontinuities (distortion) in the resulting keyed signal?

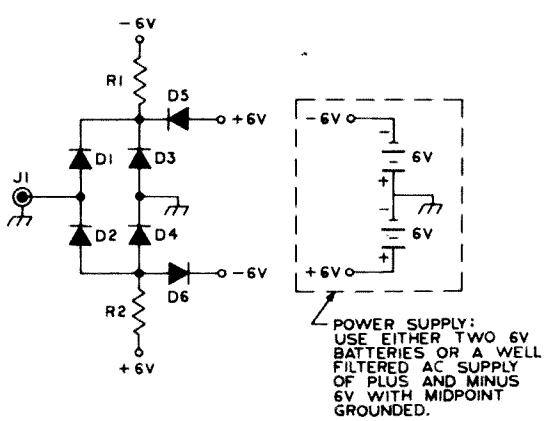


Fig. 1. A simple diode switch circuit using 6 diodes.

Suddenly the answer came – simple; the diode switch! Before I get deluged with a chorus of "Whatinhell's a diode switch?", let me explain. A diode switch is a half-dozen diodes (such as the IN4151) wired as shown in Fig. 1.

Easy, eh? Here's what happens: J1 carries the switched output. One side is already grounded and the action of the diodes causes the center terminal (the line going to the midpoint of D1 and D2) to be either open or grounded. For the open state, we apply the plus and minus 6V to D5 and D6 only. This causes diodes D1 through D4 to block both polarities of the applied voltage, causing the center terminal of J1 to stay at a very high impedance in reference to ground. In the closed state, we remove the voltages from D5 and D6 and apply them to R1 and R2. Immediately D1 through D4 conduct and effectively ground the center lead of J1 through D1 through D4 to the ground lead at the midpoint of D3 and D4. All we need now are some transistors to drive the diode switch, and a key to drive the driver transistors.

An emitter follower whose input can receive the signal from your vfo and whose output can be switched by the diode switch adds the final touch. The complete circuit is shown in Fig. 2.

Note that the circuit is set up so that the diode switch (D1 through D4) is conducting

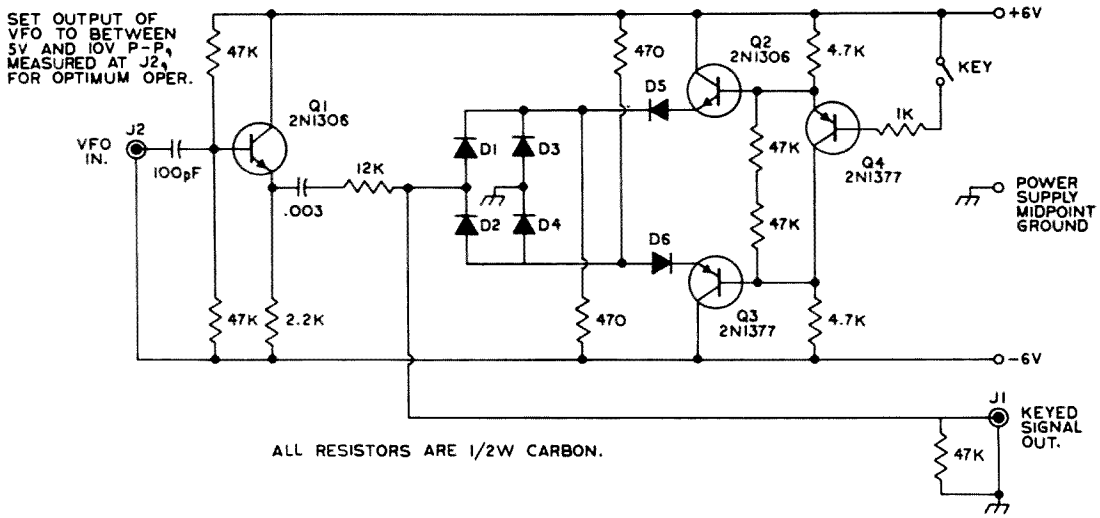


Fig. 2. The complete circuit. Note that it is set up so the diode switch (D1 through D4) is conducting with the key up.

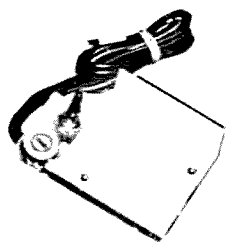
with the key up, thus turning the carrier (at J1) off. When the key is closed, the diode switch opens up, allowing the signal from the vfo (through Q1, the emitter follower isolating amplifier) to appear at J1. Since there are only 6V across the key, there is no shock hazard and the whole circuit can be wired up on a simple pegboard.

As to how fast you can key this circuit, don't bother sitting up nights building up your code speed to test its limit. This little gem will just sit back and yawn at a speed of many thousands of words a minute because the specified diodes have a recovery "speed" of 2 nanoseconds!

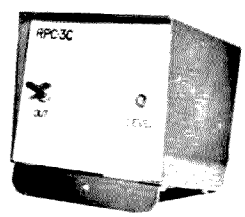
All you need now are power amplifiers with good linearity, and a well-regulated power supply to transmit the "perfect" CW signal.

...W6YBP

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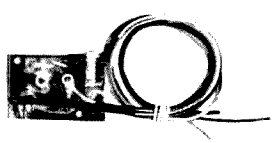
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TIPS for Raising Your Code Speed to 20 WPM

Many holders of the General or Advanced class license disavow any interest in raising their code speed to the magic rate of 20 wpm, and probably most Extra class amateurs felt the same way at some time in the past. When your code is just barely at the 13 wpm level, a speed of 20 wpm seems an impossibly difficult goal. The purpose here is to give you some practical tips on increasing your code proficiency.

Receiving and sending Morse code is purely a skill, requiring only minimal cognitive abilities. It belongs to the same class of acquired skills as learning to type, to ride a bicycle, or to ice skate. The principal ingredient needed to arrive at a certain level of performance is practice. However, the type and frequency of practice is quite important. Knowing approximately how much time will be required to increase your speed to 20 wpm can be helpful psychologically. Most of us expect faster improvement than can be reasonably expected. A realistic appreciation of the amount of practice that will be needed will help prevent the natural feeling of frustration that arises when you feel you aren't making fast enough progress. Individuals vary considerably in their learning rate for skills such as copying Morse code, but 120 to 140 hours of the right kind of practice should raise your speed from 13 wpm to 20 wpm. That amount of time may seem like a lot, but spread out over a period of time it becomes easier to contemplate. For example, if you can regularly put in 30 minutes of concentrated practice per day, five days a week for fifty weeks, your total time spent will be 125 hours. With that amount of the right kind of practice, you should be close to your goal of 20 wpm.

What is the Right Kind of Practice?

The first thought that comes to mind when you start thinking about increasing your code speed is to start having CW

contacts. Working CW will certainly help your code speed, but it isn't the fastest way to make progress for at least two reasons. First, in a QSO we generally want nearly solid copy, and as a consequence we all tend to work stations that match our own speed quite closely or even those who might be a little slower than we are. And you never increase your receiving speed unless you are pushed and made to copy material at a speed somewhat higher than your top speed for solid copy. Another reason that on-the-air QSOs tend to be inefficient as code speed improvement exercises is that their content tends to be highly repetitious. Hams unfortunately tend to say about the same things in QSO after QSO, and as a result, you can predict too easily what is coming next.

A somewhat better procedure is to spend time copying amateur or commercial stations sending at a suitable higher speed than is comfortable for you. Finding such stations is not easy, and about the time you do find an appropriate signal it will often sign off. As a result, a lot of time can be wasted tuning around looking for suitable material to copy. A better idea is to listen to one of the stations sending out code practice material on a regular schedule. The ARRL headquarters station W1AW has an extensive program of such transmissions. The detailed schedule can be found in *QST*. A number of other amateur stations across the country also feature code practice sessions at speeds in the 5 to 35 wpm range. Unfortunately, rarely more than 10 minutes is spent at any one speed. You will usually find at most two speed ranges that are really suited to your learning needs, but nonetheless these transmissions are a good source of practice material.

The Tape Recorder as a Code Instruction Device

Perhaps the best solution for obtaining suitable practice code transmissions is to prepare your own code tapes using a tape recorder. A helpful procedure is to record at half the linear tape speed, half the code speed, and half the audio frequency that you want on playback. You can use either a hand key or some form of automatic key together with an audio oscillator set at 400–500 Hz.



Can you decipher this message within 60 seconds? "Nialp hsilgne txet with all tpecxe the elttil sdrow delleps scrawkcab sekam doog ecitcarp lairetam."

Sending at half speed will enable you to record really good-sounding, accurate code characters. Plan on a playback speed 5 wpm or so above your top receiving speed. Feeling pushed during your practice sessions is quite important. To prevent memorization of the material on the tape and thus soon vitiating any practice value it would have, record plain English text with all except the little words spelled backwards. Be sure to use material containing some numbers and punctuation marks. Spelling the short, common words such as *the, an, but, for, it, on,* etc., in their normal manner is helpful because as your speed increases you will begin to recognize the short, frequent words as single-unit sounds. This type of material is better for practice than code groups because the various letters occur with the same frequency as in plain English, and you will obtain valuable experience with the important high-frequency, short-length words.

When your copy begins to get too nearly solid, prepare a new tape at a higher speed. Always keep yourself on the stretch. Before tackling that FCC Extra class examination, you should be working with a tape in the 27 to 30 wpm range, and you should be able to take almost solid copy at 22-23 wpm. You will need a margin of two or three wpm to compensate for the natural nervousness and tenseness you will feel in the FCC examination room.

How Long and Often to Practice

With a code tape available, you will be free to practice at a time to suit your own

personal convenience and as often and for as long as you wish. However, don't make any one practice session too long. Once you begin to tire, prolonging the practice period will bring diminishing returns. Probably 30 minutes is long enough for any one session. If you are really eager, one 30 minute lesson in the morning and another in the evening would not be too much per day, but most of us will find one practice period a day is about all we can or want to have.

With one 30-minute session a day, you should plan on at least a year to raise your speed from 13 wpm to a comfortable 21 to 22 wpm. If you have to miss occasional daily sessions, you ought to think in terms of 18 months. Realistic estimates of the time that will be required will reduce the frustration so often felt by aspiring Extra class candidates who have grosssly underestimated the amount of effort needed to increase their code speed merely 7 wpm.

Plateaus and Breakthroughs

A fundamental law of acquiring motor skills seems to be that progress toward a goal is never linear, but proceeds by means of a series of frustrating plateaus followed by breakthroughs to new, higher levels of performance. When you hit a plateau at 14 or 16 or 17 wpm, don't give up. Sometimes your skill may even seem to regress, but if you continue to practice regularly, you will suddenly realize one day that you can now copy at a higher speed than ever before.

Copying Behind

As your code speed increases, it becomes increasingly important to copy behind by a letter or two, or even by a whole word. Copying behind simply means that the operator does not write down the character that is being sent, but lags behind by one or more characters. Copying behind has the effect of smoothing out the rate at which code characters must be transcribed, and does away with the panicky feeling resulting from trying to write down each character before the next one is heard. As code speed increases, a certain amount of copying behind becomes almost mandatory if one is to keep from feeling too frantic, but fortunately the ability to copy behind will tend to develop more or less naturally. However, the rate at which your code speed will increase can be accelerated if you make a deliberate effort to try to copy behind. Force yourself to carry a letter or two in your head before writing them down. At first this procedure will seem difficult and unnatural, but you will soon get the hang of it.

Sending

From all that has been said so far, you might conclude that the FCC examination covers only the ability to receive Morse code, but of course you must demonstrate your ability to send at 20 wpm as well. The type of key you want to use is up to you. Since the FCC furnishes only a standard, manual key, you must bring along your own if you want to use a special type key, such as a bug or an electronic keyer. Learning to use some type of automatic key is not necessary in order to pass the code text at 20 wpm. Most individuals find a speed of 20 wpm relatively easy to reach with a standard key, but for speeds much higher, the majority of us find some type of automatic key mandatory. Generally, considerably less practice is needed to raise your sending speed than for the corresponding increase in receiving speed. In your sending practice, the emphasis should be on quality and accuracy. One easy way to monitor quality is to record periodically a few minutes of your sending with a tape recorder, and then listen critically both at normal playback speed and at half speed. You will easily be able to detect



You must feel pushed during your practice sessions for best results.



If keeping cool and calm during the exam is half the battle, guess which guy will pass?

any abnormally formed characters, and can take steps to correct them.

The FCC Examination

That fearful yet wonderful day has arrived – you are going to present yourself at the FCC district office for the examination. As a candidate for the Extra class license, you have one marked advantage over the General or Advanced class aspirant – you have been through it before. However, if you are an oldtimer, you may fear that your last visit to an FCC office was so long ago that everything is different now. I can assure you on the basis of personal experience that nothing has changed, at least not in the last twenty years. The five-minute code transmission is sent automatically be means of a punched paper tape machine, and you will be provided with a pair of black, lightweight earphones for listening. The code message to be copied is preceded by a long string of *v's*. Although the text material proper is in plain English, it contains a generous number of punctuation marks, numbers, and even an occasional Q-signal. One minute of error-free copy, i.e. 100 consecutive correct characters in the 20 wpm range, is all that is required. If you pass the receiving test, the engineer will give you a chance to demonstrate your sending ability. No precise timing of sending speed is made, but if you send markedly too slowly, you will be asked to increase your speed. Nearly all who pass the receiving test also pass the sending test. Once past the code hurdle, you are given a chance at the written part of the test, but if you should fail the code test, the engineer will politely tell you to try again in thirty days, and all that has been lost is an hour of your time, and, alas, nine dollars.

Best of luck to you. I'll be seeing you on the Extra class bands.

. . .W7OXD

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WHY NOT TRY QRP?

In this day of kilowatts there is relatively little low-power operation. But running QRP can be a lot of fun, even if you don't get a lot of QSO's.

When running high power all one has to do is hit the key or blow into the mike and he gets a QSO. He can talk to just about anyone he wants. But after awhile one comes to realize there is not much fun to this. One can achieve the same effect by dialing the telephone at random, and save a lot of electricity while doing it.

When one starts running QRP, hamming takes on a new challenge. No longer does one say "QRZ-599-73-QRZ" endlessly. It is *work* to get a QSO, and much more of a thrill to get it with QRP. I really got a kick out of working FP8AP on 40 CW during the afternoon with 10W, while I thought nothing at all of working ZD8OFE with 180W of SSB on 20.

Before trying real QRP, such a 1W or less, it would be a good idea to start out with *relatively* low power. Try something like 10–15W, but not much more. This power is low enough to provide some of the fun of QRP, but not so low that contacts come really hard. It is a good idea to start out with rather high powered QRP, to get used to it gradually. If one were to start out running something like ½W, he would of course have a rather large contacts-to-calls ratio and would quickly become discouraged. But by starting out rather high, and getting used to low power operation, the small number of QSO's with real QRP won't bother a person as much.

I would not recommend much over 15W to start out with. While many will disagree, I consider something like 20–30W in almost the same class as 75–100W. With 20W it is possible to get quite a lot of QSO's. I have worked 45 States on 40 CW with 25W, and many, many QSO's, and lots of others have done the same.

It is hard enough getting QSO's with a watt or so under the best of conditions, and especially when the operator has no experience running that much. I would suggest for a start you confine your experiments to

less crowded bands, like 80 meters. If you want to try 40 or higher – to get better distances – try and keep away from the more crowded parts of the bands.

Here are a few things to know before trying QRP:

1) Vfo operation is infinitely better than using crystals.

This is obvious in normal high-power operation, and much more so with QRP. What can you do if there is a kilowatt sitting on each of your crystal frequencies? And what good will a crystal for 7130 kHz do if all the activity is under 7100? You must put your signal where people will hear it right away. In these days of vfo's almost no one tunes after a CW. Even if they do tune around, they will probably hear someone else calling CQ and call them, leaving you out in the cold.

2) Wait until conditions are good.

If you hear a 559 signal tell someone he is running a kilowatt to a 100 ft high dipole, you can be pretty sure your 100 mW will be unreadable there. If someone is S 8-9 you can be reasonably sure he will hear you. But don't bother with S 6-7 signals unless you know they are also running QRP.

3) Call others, don't call CQ.

Anyone will tell you that a low power station has a better chance if he calls others. And when calling others, make sure no one else is. If you hear three 599+++ signals calling him you can be sure you will be drowned out. If you only hear weak ones calling, give it a try; you may be lucky and be the one he comes back to. Also, remember that if someone hears a 539 signal calling CQ he will assume that conditions are bad, and not bother calling.

Some will disagree on the point about calling while others are. For some, competing with QRO stations is half the fun of QRP, while others, like me, just like to get a maximum of QSO's with a minimum of trouble.

4) Don't settle for lousy antennas.

If your 100W rig does not get out well you can be certain that your 1W won't get out at all. You are already operating under a 20 dB or more handicap when running QRP, so don't make things worse by using an antenna that has loss rather than gain.

Of course, don't spend a fortune on copper and towers before trying QRP – give your existing antennas a try – you may be surprised. Read on to the examples of what has been done with QRP and look at what I did. I did it all with 10–15 ft high dipoles and a 20m vertical. (I do, however, have several logbooks full of unanswered calls, and many premature gray hairs from it.)

VE1ASJ has worked many stations on 80m CW, using 100 mW, and has worked as far West as VE5 and W6. His antenna is a three-element wire beam!!!

Some of you may have heard of the QRP Club, International. Members are limited to 100W and it has 3,000 members in 57 countries. Many of them experiment with low power. Later on are some of their accomplishments with QRPP. (QRPP is becoming the generally accepted term used for QRP Power, designating an input of 5W or less.)

The QRP Club issues several awards. One of them really has the low power operator in mind. It is the "1000 Miles per Watt" award, also called the "KM/W." It is issued for *either* transmitting *or receiving* signals from a low power station such that the great circle distance between stations divided by the power of the low power station equals or exceeds 1000 miles per watt. It is issued for work on different bands and modes. Over 150 of them have been issued. Perhaps thanks to the influence of this award, the generally accepted measure of QRP DX is "miles per watt."

This award is not really hard to win. Several people have even won it more than once. Here are some of those who have several hanging on their walls, and the bands and modes they used:

W9UZS – 40, 20, 10 CW
WA5NOM – 80, 40, 20 CW
VK3XB – 40 fone and CW, 20 fone and CW
W6TYP – 40 and 20 CW, 80, 10 2 fone*
WA8MCQ – 80, 40, 20, 15, 10 CW, plus one for receiving on 40 CW

*Current official record holder

When trying for this award, remember that the distance in miles one must work is equal to one thousand times the watts input,

or one mile per milliwatt input; eg., 2 watts need 2000 miles; 5 watts needs 5000 miles, and 250 milliwatts needs 250 miles.

The QRP Club also has another award. It is the "QRPP-WAS" Award, for working states in steps of 10, 20, 30, 40, 45, and 50. (The reason for the 45 state class is that the last five states really come hard, especially when running QRPP, so people won't get discouraged as they approach 50.) For this award, the maximum power that may be used is 5W, and there is an endorsement for using under 1W.

Here are a few of the things being done with QRPP:

WA8MCQ: I have worked 47 states with 800 mW and under. Anyone in KH6, Oregon or New Mexico want to sked me? I have the KM/W six times, and have qualified many others for it by running low power. Have over 300 contacts with under 1W, and often run the 80 mW rig in contests, and make at least 20 contacts, and made 73 once. I usually establish contact with the small rig, but a few times I use the big rig first, and ask people to listen for my QRPP, in order to get a few of the harder states.

WA5BMN: Used to keep regular skeds with W6TYP, running under ½W both ways.

WB2YPA: Running 3 mW he worked WA6ZHP, a QSO good for 800,000 miles per watt. This fantastic feat is close to the official record, which is held by W6TYP.

WA8RQQ: Worked several VK's with 10W and less, plus much more DX, including 11 countries with under 5W. Of course he has the KM/W. He even worked an HK3 on 40 CW at *noon* with 1W, and got a report of *599*!!

W8AVB: Has a 200 mW vfo rig for 80 meters, with which he worked at least 30 states, including some 6's and 7's,

W7IGV: Had been keeping regular skeds with W6EAC on 40 CW, both using 1 to 2 watts. One day W7IGV showed up on sked "maritime mobile" from a rowboat on Lake Coeur d'Alene in Idaho! W6EAC could hear him but could not copy. The effort was not wasted, however, as WA7BIY, running 5W, W7OE and WA7FYW, all in Washington, broke in, and solid copy all around. W7IGV's antenna was 10 ft of loaded whip. (From Sept. 1968 issue of *Random Radiation* official organ of the Pacific Amateur Radio Guild, published by W7OE.)

WA9MFZ: Running 2W he worked a station in Colorado who was running 800W, and got a report of only 2 S-units lower – pretty good for a 26 dB power difference!

W6TYP: Art has worked at least 24 states with under ½W, plus 4 countries including ZL. He is the current official record holder for miles per watt. He worked WA6JPR on 40 CW to set the record. He was running 354 *microwatts*, and the other guy was 354 miles away, a QSO good for one million miles per watt.

W2UUV: According to a letter in the October 1964 issue of *QST*, on page 104, he is the unofficcial record holder for miles per watt. He worked W2BNA, 205 miles away, while running 67 *microwatts*, a contact good for over *three million miles per watt!!* This guy has got to be one of the top QRPPers around, as far as miles per watts go. He logged 15 successful attempts out of 15 to make over 105,000 miles per watt, working with W2BNA, a 205 mile path with a milliwatt and less. He says that W2BNA is tops, and often runs up scores of over 600,000 miles per watt. He also says that K1HNJ made 769,000 miles per watt, at 100 miles and 130 microwatts. He says he has 31 states plus KZ5 and DJ, all on 80 meter with 180 mW. Sometimes he runs his final off a solar-battery which he puts in the window, and others get quite a kick out of it. He also sponsored a "QRPP QSO Party" a couple of years ago, in which the maximum input allowed was 300 mW.

The foregoing should inspire some of you QRO people to give QRP a try. It's lots of fun, and beats running a KW anytime. (Note; I meant it's more fun than running a KW, *not* that it will do better than a KW!)

Anyone interested in joining the QRP Club can obtain information and application blank by sending a self-addressed stamped envelope to K3YNN, the Corresponding Secretary of the Club. Lifetime dues for the club are only $2.

Whenever you are on the air, give a listen for some of those real weak signals you hear, and you may make some. QRPPer very happy.

. . .WA8MCQ


W4BP



This is what the well-equipped ham of the thirties called his shack. Even by today's standards, he can do a lot.

Glen E. Zook, K9STH
818 Brentwood Lane
Richardson, Texas 75080

VHF DUMMY LOAD WATTMETER

The active vhf amateur often has need of some type of dummy load for transmitter checkouts. The units found in amateur applications range from the Bird "Termaline" units costing around $350, downward through the Waters units, through the Heathkit Cantenna, to the inexpensive units described in the various amateur publications.[1] The Bird and Waters units have the advantage of a direct readout wattmeter movement, whereas the cheaper units are dummy loads only. A dummy load serves as a constant impedance load while keeping the signal from interferring with other amateurs. When a wattmeter or relative output meter is added, the dummy load becomes a very useful piece of equipment.

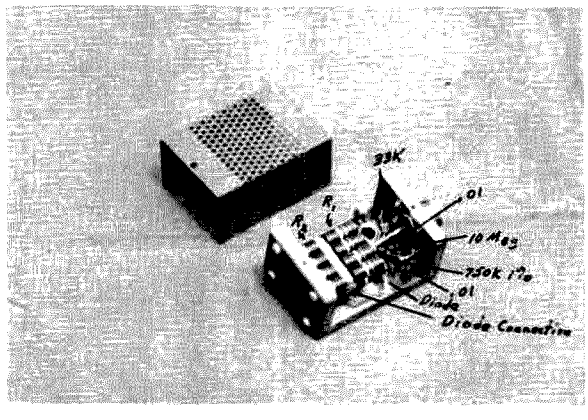
The unit

The unit described herein is similar to some 60 watt units which may be found around many commercial two-way radio shops. This dummy load has provision for connection to an external relative output meter. This external output meter may become an accurate wattmeter if the following criteria are met:

1. Frequency bandwidth of $\pm$10% of calibration frequency.
2. RF output kept within power dissipation of dummy load.
3. Accurate initial calibration.

These criteria may be easily met in amateur vhf operation if only one band is considered for each set of calibration data. Since most vhf amateurs operate on 50 mhz, 144 mhz or 432 mhz, the $\pm$ 10% frequency limitations may be easily met. This limitation gives a 10 mhz bandwidth at 50 mhz, 29 mhz bandwidth at 144 mhz, and 86 mhz at 432 mhz. The limitation to the power ratings of the dummy load is only common sense, for if a resistive network is overloaded, the impedance may be drastically increased, caused by damage to the load resistors. The calibration limitation may be overcome if a standard, previously calibrated unit, or commercial unit is used.

The unit may be built for less than six dollars (less meter movement) if all new parts are purchased from Allied Radio, or at much less if a little scrounging takes place. The unit consists basically of 16 220 ohm resistors in a series parallel arrangement. The metering circuit consists of a germanium diode pickup with necessary *rf* filtering. The meter movement is generally a vom, but any 50 μa meter movement should suffice. Exact physical



Parts layout and interior view of Dummy Load – Wattmeter

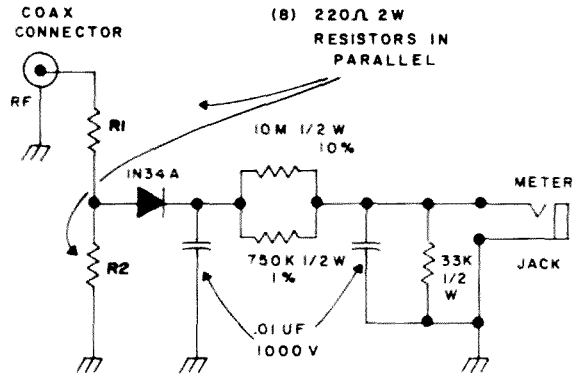


Fig. 1. Schematic. R1 and R2 consist of eight resistors each, in parallel.

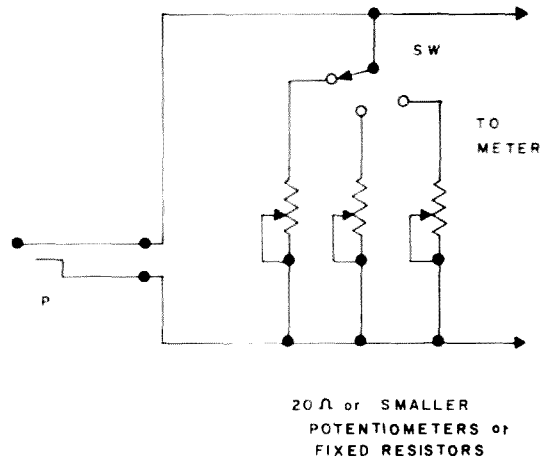
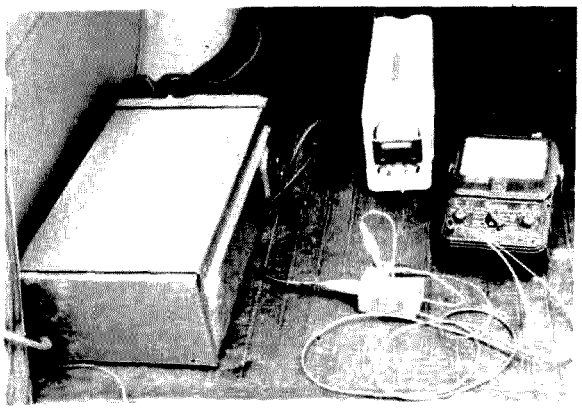


Fig. 2. Metering shunts.

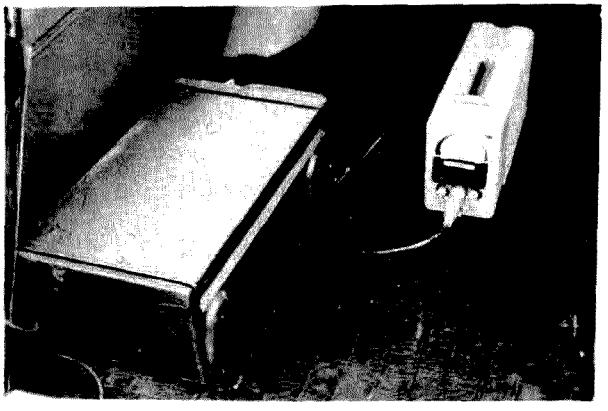
layout is not extremely critical, but it is suggested that the layout be made similar to the unit shown in the accompanying photographs. This unit is acceptable for 60 watt output transmitters without modification. The power capability may be increased to about 200 watts if the resistive network is suspended in 1 quart of oil. If this is done, care must be taken to keep the metering circuit out of the oil. The lead from the diode to the resistive network must, of course, be partly submerged, but keep the diode itself out of the oil. I do not personally use this arrangement, but I know of two units which have been in use at a large Southeastern two-way radio shop for several years. The same shop has incorporated a range switch with several meter shunts for various maximum scale power readings. This feature is especially useful to the amateur vhf fm operator who may be working with equipment of from ½ to 250 watt outputs. The schematic appears as **Fig. 1**, and the basic circuit for various meter shunts as **Fig. 2**.

Calibration

Calibration is best accomplished by using a Bird "Thruline" or similar commercial vhf inline wattmeter. Second choice is a Bird "Termaline" or similar dummy load-wattmeter. In both cases, a graph should be created by plotting meter divisions on the horizontal axis, and power on the vertical axis. The meter shunt should be placed at minimum resistance and increased to give maximum reading at the desired power level (this holds primarily true for units using the metering circuit of **Fig. 2**) or, if a vom or vtvm is being used the range switch should be placed on a high voltage setting and reduced a setting at a time until the desired reading is obtained. The transmitter should be adjusted for various power levels on the standard wattmeter and the voltage or current reading on the new meter recorded on the graph. In the case where the standard meter is of the dummy load-wattmeter type, it will be necessary to switch the coax from one unit to the other. Do not retune the transmitter, for each unit will present almost the same load to the transmitter (50 ohms). Take the reading and record as with an inline type of meter. The points on the graph should now be connected with a smooth curve (use of a draftsman's



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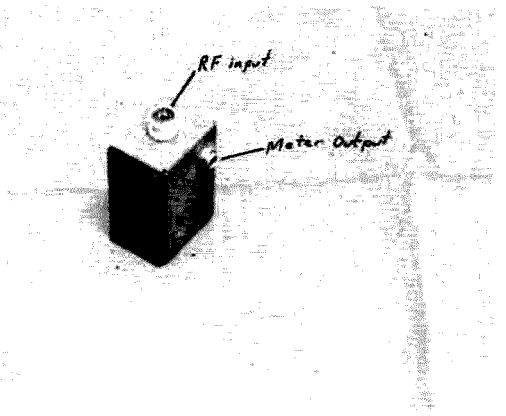
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External view.

range switch is used, it will be necessary to calibrate for each switch position. Also, if multi-band use is expected, the graphs must be made for each band. Use of the wattmeter now requires only the connection to the transmitter, setting of range switch to the proper level, and reading the graph.

Uses

The uses of this dummy load-wattmeter are as varied as the amateur mind can devise. One very important use is determining the losses of 50 ohm coax. Measure the output of the transmitter at the transmitter. Then measure the output at the end of the length of coax. The losses in the line become apparent. The loss in db may be calculated by the standard power ratio formula, 10 $\log_{10}$ Power out of coax/Power into coax.

Another use is the determination of efficiency of final amplifier stages. This efficiency may be calculated by Power out (measured by dummy load-wattmeter)/Power in (measured by plate current/plate voltage meter) x 100%. A third use is determining once and for all which amateur really has the most output. This list may be expanded by the builder to suit his own tastes.

Conclusion

This dummy load-wattmeter is not a Bird "Termaline" nor should it be regarded as a substitute for any other laboratory equipment. However, with a little care in calibration, (assuming a 5% accuracy standard is used for initial calibration) the accuracy should be within 10%, and this, my friend, is not bad for a wattmeter costing less than $10.

...K9STH

Bibliography

Johnson, Neil–A $2 200-Watt Dummy Load; 73 Magazine; May 1967; p. 66.

Calvin Sondgeroth W9ZTK
800 Fifth Avenue
Mendota IL 61342

An Experimental Sweep Oscillator

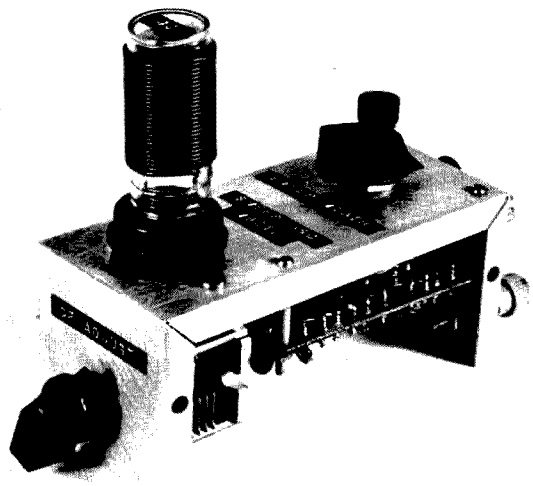
This article describes a sweep frequency oscillator that was put together to gain some experience before tackling a more sophisticated instrument to be used in a specific application. The unit described is relatively simple and can be used to sweep a signal across all or any portion of the ham bands below ten meters.

The heart of this device is a special diode called a varicap. All diodes exhibit some capacitance across their terminals when they are reverse biased; i. e. when a positive dc potential is applied to the anode with the cathode returned to the negative side of the supply. Varicaps are fabricated by special processes to make their capacitance in the reverse biased condition vary in proportion to the amount of bias voltage applied. A plot of the capacity variation with voltage is shown in **Fig. 1**. While the curve is not linear, it can be seen that from about 2 volts on up it does not vary too much from a straight line. Also, not much capacity change occurs above 5 volts bias, so the range from about 2 to 5 volts is the most useful part of the curve.

The curve in **Fig. 1** is normalized to unity capacity at 4 volts bias because nominal varicap capacities are specified at this bias level. To use the curve, the nominal value of the diode to be used is multiplied by the factor on the vertical scale at the bias applied to determine the capacity at that bias level. For example, the varicap used in this sweep oscillator has a nominal value of 12pF. If the bias voltage were 2 volts, the multiplying factor from the curve is about 1.4, so the capacity at 2 volts bias is 1.4 x 12 or 16.8pF. At 6 volts bias the factor is about 0.82 and the capacity at this voltage is 0.82 x 12 or just a little under 10pF.

Before beginning this project, some theoretical plots were made to see how a sweep oscillator with a varicap in the tuned circuit should function in terms of sweep widths with diodes of different increasing nominal values. These curves are shown in **Fig. 2**. The 80 meter band was selected for the calculations with 12, 33, 47, and 68pF diodes in the tuned circuit of the oscillator. The curves were set up so that the oscillator is on the same frequency at 4 volts bias no matter which diode is in the circuit. The total tuning capacity at this point was assumed to be 100pF. As the curves show, the entire 80 meter band could be covered with a 47pF varicap with reasonably good linearity. By limiting the voltage variation with the 47 and 68pF diodes, any portion of the band could be covered. On the basis of these curves at 3.5 MHz, the higher bands, where less capacity change is required for a given frequency shift, should present no problem.

To make an elementary sweep oscillator it is then necessary to provide the frequency determining circuit of the oscillator with a varicap as part of the capacitive element and



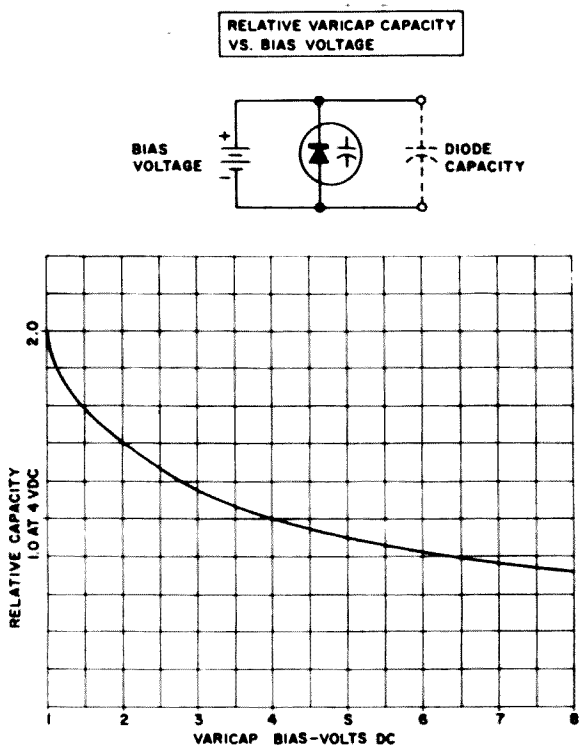


Fig. 1.

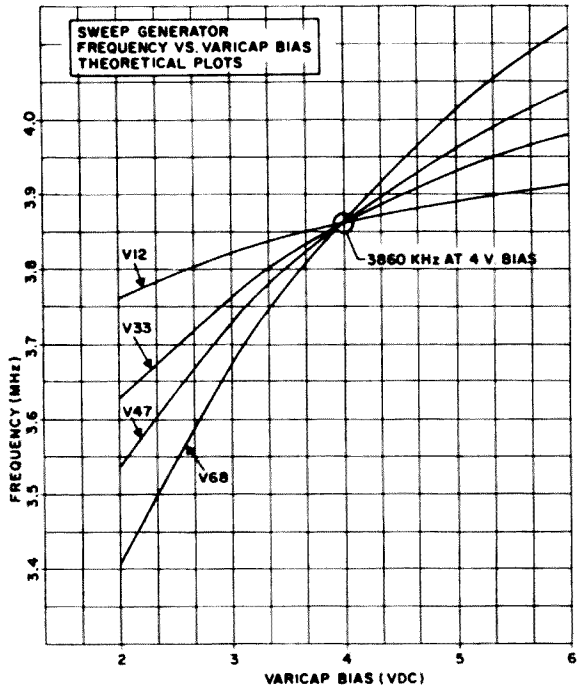


Fig. 2.

find some way to vary the dc potential across the varicap repetitively. The schematic diagram is shown in Fig. 3.

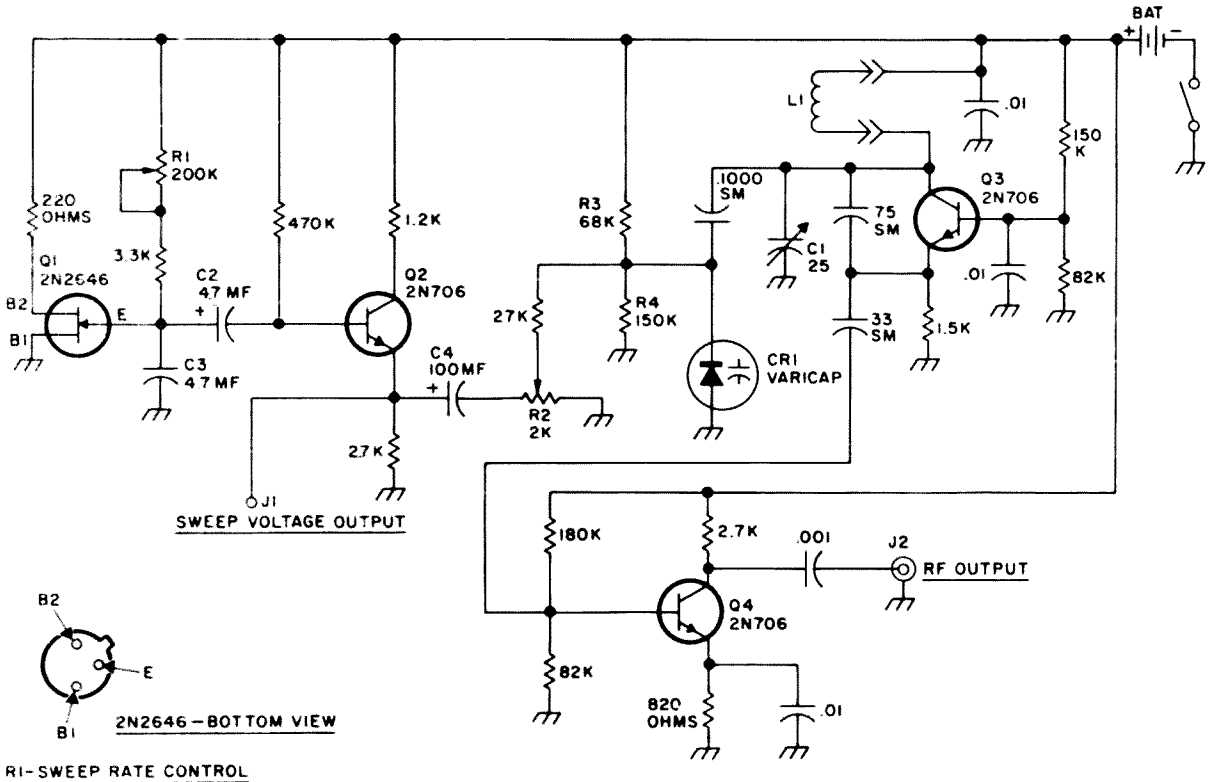
Q1 is a unijunction transistor relaxation oscillator that generates a sawtooth waveform. This sawtooth is used to provide the voltage variation across the varicap to provide the sweep function. The potentiometer R1 sets the sweep speed and can adjust the sweep rate from under one sweep per second up to about 50 sweeps per second. The sawtooth from the unijunction is coupled into Q2 which feeds the varying dc voltage to the varicap. Q2 also provides a sweep output that can be applied to an oscilloscope as will be described later. Potentiometer R2 adjusts the amount of voltage variation applied across the varicap which controls the amount of frequency shift or sweep width.

The oscillator section is straightforward. The 25pF air variable capacitor C1 is used to set the center frequency around which the oscillator is to be swept. The frequency set capacitor is kept at a small value so that the relatively small variations in varicap capacity have a sufficient effect on the frequency and thus the sweep width. At the higher frequencies not much capacity variation is required, and the width of sweep can be adjusted by R2 if it becomes too great.

Q4 is used as a straight amplifier to boost the output signal to a usable level and to provide isolation between the oscillator and whatever load might be applied. The unit described provided about 2.5 volts rms on the 40 meter band and about a volt rms on 20 into a high impedance load.

The unit shown in the photograph was built in a 2¼ x 2¼ x 5" Minibox. As was mentioned earlier, this project started out as an experiment and a larger enclosure might have been better since the parts became rather crowded after several additions and modifications were made. The center frequency adjust capacitor C1 is mounted on the front apron of the box with an octal socket for the plug in coils mounted immediately above it on top. The sweep width potentiometer R2 is mounted on top toward the rear. On the rear apron are the sweep rate control R1, a BNC *rf* output connector and a universal binding post for the external sweep output connection. Originally it was planned to use a fixed sweep rate, but when a variable rate was found to be useful the rate control took the spot that was intended for an on-off switch for an internal battery. As a result, two binding posts were mounted for connection to an external battery or power supply.

The circuit is wired up in typical transistor construction fashion on a phenolic board. The unijunction circuitry is toward the rear and the oscillator/output amplifier



R1-SWEEP RATE CONTROL

R2-SWEEP WIDTH CONTROL

COIL TABLE		
FREQUENCY	DIAMETER	WINDING
7 MHz	7/8"	26 TURNS – 1 1/8" LONG
14 MHz	7/8"	7 TURNS – 1/2" LONG

Fig. 3. Schematic.

GENERAL NOTES ON SCHEMATIC – FIG 3

ALL FIXED RESISTORS ARE 1/4 WATT COMPOSITION
.001 AND .01 CAPACITORS ARE DISC CERAMIC
CAPACITORS MARKED "SM" ARE SILVER MICA R1
AND R2 STANDARD CARBON ELEMENT POTENTIOMETERS
C2, C3, AND C4 ARE ELECTROLYTICS – 25WVDC OR MORE

toward the front near the center frequency capacitor. The board is supported on 1" pacers from the top of the minibox.

The plug-in coils are wound on plastic coil forms (I used pill bottles) 7/8 inch in diameter. Winding data is given in the table. After the turns have been adjusted to cover the desired range the forms are cemented to octal plugs. The only coils wound for this experimental version were for the 40 and 20 meter bands.

Amateur bands were chosen for ease in checking sweep widths with the bandspread scales on a receiver. When the oscillator is functioning it can be heard sweeping across the band in use. By tuning across the band, the upper and lower limits of the sweep range can be found when the thumps as the oscillator goes by can no longer be heard. With the circuit shown it was possible to sweep all but about 30 kHz of the 40 meter band, and on 20 meters the sweep width was a little over 400 kHz, covering more than the whole band. Minimum sweep width on both 20 and 40 was between 10 and 20 kHz. No attempt was made to calibrate the center frequency capacitor because this can be found by the receiver calibration. Also, the center frequency depends somewhat on the sweep setting, as is explained later.

Applications for this device will probably suggest themselves to anyone interested in trying such a gadget. Of course it can be used in conjunction with an oscilloscope to get a visual display of the frequency response of the tuned circuits in an *rf* amplifier by connecting the external sweep output to the horizontal input of the scope and the amplifier output to the vertical channel. Also, by just using the external sweep



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connected to the horizontal input, sweep speeds lower than provided by the usual garden variety scope can be obtained.

In conclusion, a few comments on the circuit might be in order. No provision was made for turning off the sweep; but by turning the sweep rate control to its maximum resistance position, the unijunction stops and thus the sweep. I found that the signal, with the sweep stooped, sounded rather coarse in the receiver; but this is probably due to noise, etc., being picked up by the varicap.

The varicap used is a V12E manufactured by Pacific Semiconductors. This series is available values from 7pF to 100pF so wider sweep ranges could easily be achieved. They are available from Allied Radio for about $3.00.

As was mentioned before, an external power source was used. Supply voltages from 12 to 18 volts are about right, but it should be pointed out that the resistors R3 and R4 must be adjusted to suit the supply voltage used. These resistors (along with R2 and the 27K resistor feeding the sawtooth to the varicap) form a voltage divider which sets the static bias on the varicap. To set this up, set the sweep rate at a low speed and connect a vtvm across the varicap. As the voltage divider R3 and R4 is adjusted the vtvm will swing back and forth slowly with the sweep. The divider should be adjusted so the meter swings around approximately 3.5v as a center point. Since the sweep width control R2 is in parallel with R4 through the 27K resistor, changing the sweep width will also change the center frequency slightly because the static bias level on the varicap will be changed.

The curves of Fig. 2, while being theoretically sound, cannot be duplicated on 80 meters with the circuit shown because the voltage shift across the varicap is not enough to produce the shifts shown.

Although this generator is rather simple, it proved to be a very interesting project and much was learned. The general circuit shown, with varicaps of larger value and suitable coils, should be capable of providing any desired shift at any frequency. An obvious application would be to build this sort of device to tune 455 kHz (or other if frequencies) for receiver alignment purposes. A different oscillator circuit would be required and plans are under way to try this in the future.

. . . W9ZTK

WHO CAN'T LEARN THE CODE?





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I'd give anything to get an amateur license, but I'm one of those people who just can't learn the code." It seems there are more of these unfortunates each year swirling around the fringes of ham radio. Let me tell you how this supposed inability to absorb an elementary skill all began.

Many years ago there was no such thing as a person who couldn't learn the code. With equal enthusiasm young Johnny Ham tackled learning the code and how to build and operate his station. The required code speed in those days was only 10 words per minute for the General Class license, but then the only reason the FCC has since raised it to 13 wpm, I understand, was in response to the widespread conviction that the present generation has at least 30% more on the ball than the preceding one.

Then along came WWII with its urgent demand for far more military CW operators than amateurs could possibly supply. The armed forces set up radio schools and one of the entrance requirements was to pass a "code aptitude" test. Fellows with recent exposure to military methods can vouchsafe that even today the armed forces are not notably successful in placing men in the areas of their greatest talent and interest.

Imagine then how it was 30 years ago in the hurry and confusion of an approaching war. Great numbers of would-be radio operators were told they had no code aptitude and were summarily sent off to become cooks or hospital orderlies – for which they probably had no aptitude either.

With war's end and the resumption of amateur radio it didn't take long for the miliary radio school dropouts to spread the idea that many people lack the wits to learn the code. Nonsense.

Anyone who has learned that when he hears the three syllables 'dou-ble-you" pronounced it represents the letter W can also learn that three other syllables, "dit-dah-dah" represent the same letter in Morse code. If one letter can be learned so can the others – it's that easy. Building up speed is then a simple matter of repetition just as in any other subconscious skill, like tying your shoes, for instance.

Is there a valid argument to the contrary? If there is, I've never heard it!

. . .W0HKF■

John Boyd WAØAYP
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Midland MI 48640

The Greater Dipper

Introduction

To the uninitiated, a grid dip oscillator is neither glamorous nor exotic, even if it does happen to be transistorized. But to those who have ever tried to put a coil on frequency, one is worth its weight in microcircuits.

The original model of the *Great Dipper* proved to be a versatile, if unexciting, grid dip oscillator. Intended to be used mostly at VHF, the dipper was limited to frequencies above 28 MHz. To those who seldom operate above 10 meters, the lack of frequency coverage below 28 MHz was a definite handicap. Expanding the frequency coverage downward extends the dipper's usefulness considerably.

Component changes made were not extensive, nor were the physical dimensions of the unit changed. The schematic diagram of the modified circuit is shown in Fig. 1, and the pictorial diagram of Fig. 2 is included to supplement the photographs printed in the original article.

Modification

First, the oscillator circuit board should be rotated 90 degrees from its original position so that transistor substitution or replacement can be made easily. A microwave diode might be substituted for the original glass computer-type diode; this results in better performance at VHF, but its effect cannot be accurately predicted. A 1N21 or 1N23 diode could be used in place of the D4900 called for in the schematic. Best oscillator performance over a wide frequency range results from using a 5 pF capacitor as the collector feedback coupler, but this was a compromise value. If operation is likely to be confined to either the HF or VHF segments of the radio spectrum, some experimentation with this capacitor should result in improved performance over that particular range. For experimentation, use a 3-12 pF or 4-30 pF trimmer.

To perk up meter amplifier performance, replace the 2N918, a relatively high gain, low leakage transistor. Meter amplifiers are not difficult to construct, and more information on them can be obtained from articles published in 73 Magazine.[2,3]

Although the change was not made in this unit, a 6-100 pF (MAPC-100) variable capacitor could be substituted for the existing 5-50 pF unit. As can be seen from the full-size scales, frequency coverage is narrow on the 13-23 MHz plug-in coil. Those who

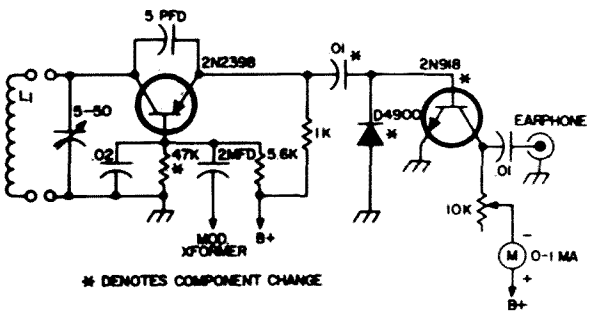


*Fig. 1. Schematic of modified circuit, with component changes indicated by *. L1: 13-23 MHz, 14½ turns No. 20; 22-44 MHz, 5¼ turns No. 24, 45-90 MHz, 1½ turns No. 24; 90-195 MHz, 2½ x 3/8 in.*

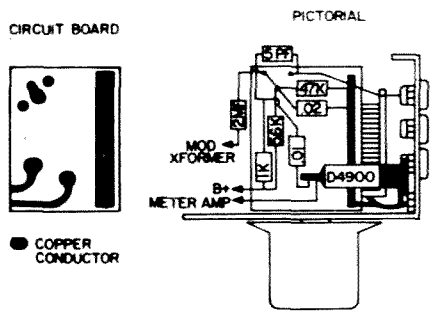


Fig. 2. Pictorial view of the dipper and its circuit board.

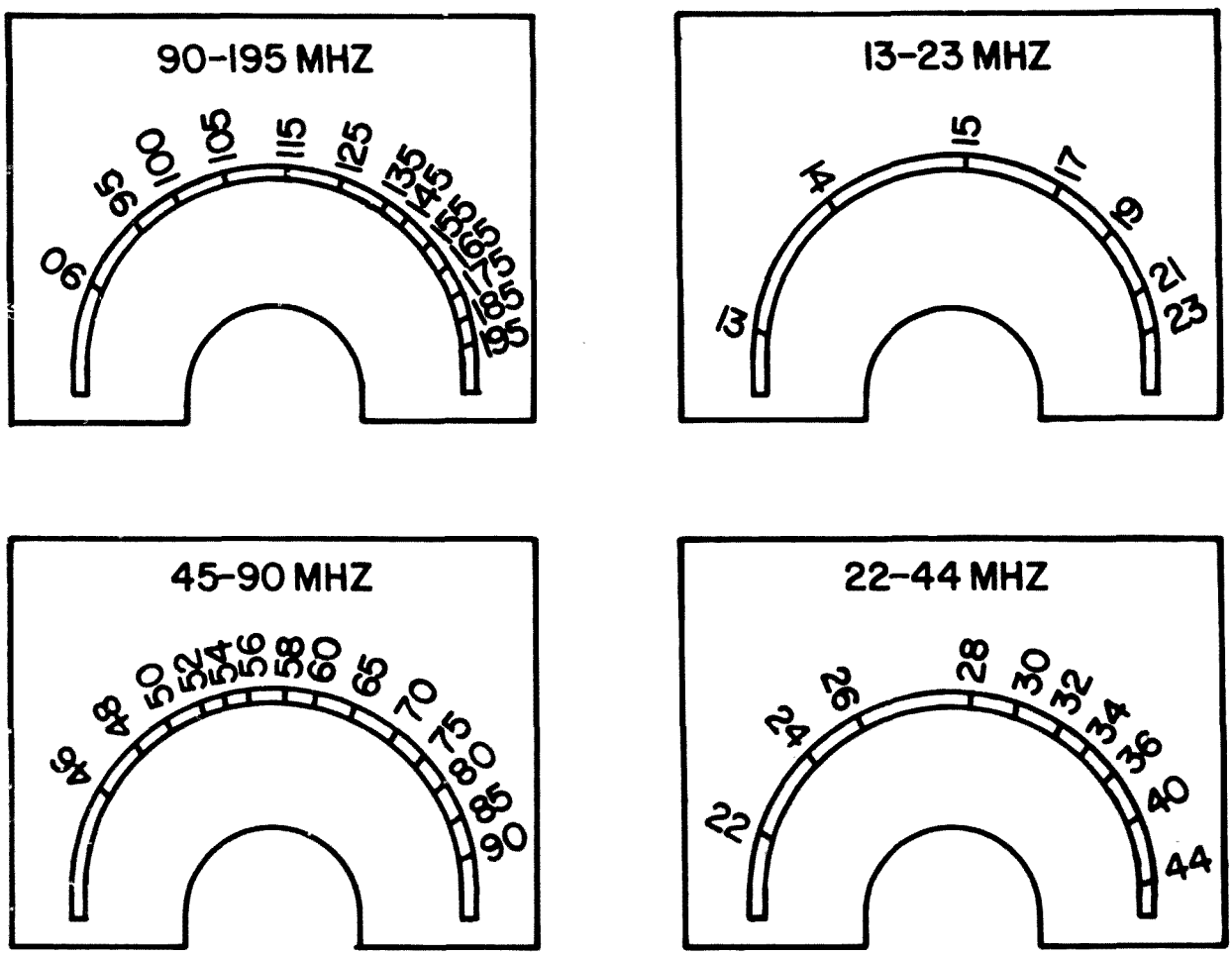


Fig. 3. Dial designs for the various MHz ranges, full size.

frequently construct HF gear might benefit from the substitution.

Operation

Operation of the dipper is the same as before, except the frequency range is greater. Another coil must be wound for the 10-25 MHz range, but existing coils were not modified. Calibration is now different from before; full-size scales are included with this article for those who do not have a general-coverage receiver or another grid dip oscillator on hand for calibration.

Oscillation is still vigorous at 13 MHz, which indicates lower frequencies may be reached with a suitable coil plugged in. Similarly, oscillation is still noticeable at 195 MHz, so operation at higher frequencies may be possible.

Finishing Touches

Appearance of the dipper was improved after enlisting the help of a draftsman. The dial and meter scales were professionally inked. **Figure 3** provides full-size copies of these scales.

To improve the legibility of the labels and scales, they were inked on yellow cards rather than on conventional white paper. It's a small point, but for those who use test equipment frequently, the black-on-yellow technique results in less eye strain.

Pull the plug on the rig; in its stead, plug in your trusty (rusty) soldering iron and get started on this small project.

. . . WAØ AYP■

Notes:

1. "The Great Dipper," John Boyd WAØAYP, August, 1967, 73 Magazine, p. 42.
2. "Transistor Meter Amplifiers," Jim Fisk WA6BSO, January, 1966, 73 Magazine, p. 44.
3. "73 Useful Transistor Circuits," Jim Fisk W1DTY, $1 from 73 Magazine, p. 31A.

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Mt. Edgecumbe AK 99835

CQ DX on ½ WATT

If someone had told me that one day I would be getting out on the air *too* well I would have administered a well-placed kick and gone back to grumbling about TVI, ignition noise, tower restrictions, and the like. Well, here I was on an isolated Coast Guard station far from TV and motor vehicles. I had a full kilowatt and a tower topped with a three-element beam. And I was bored.

In the first six months on the island I had worked DX as I had never done before. I operated USB, LSB, DSB, and NO SB (CW) – and the DX poured right in. Before long, however, the novelty began to wear mighty thin and, since I am not a certificate collector, I began to cast around for something new.

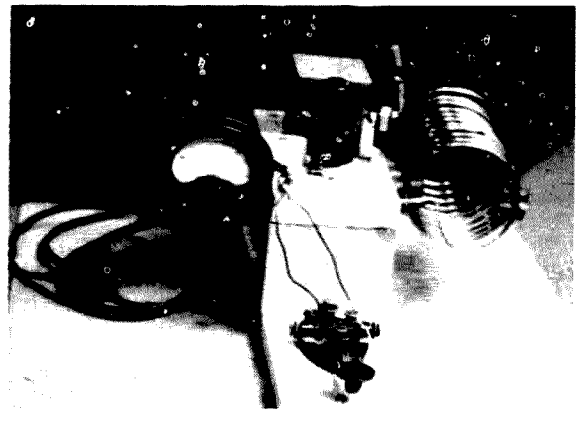
The idea of QRP operation ("low power," if you're not in the know) came by accident as I listened around the band one night. There at the low end of 20 was a UA9 calling CQ. Deftly, I zeroed in on him and keyed back the usual short, confident reply. As I rapped out *KN*, I realized that in my haste I had neglected to flip the plate switch on the Thunderclap XVII. Without the big rig, I was naked – a defenseless victim for QRN, QRM, and QSB. I would never get through. But what was this? An answer!

My hand shook on the key: "Rig is running 100 watts," I said.

"FB Sig," he said.

I had done it. I had broken through the power barrier. Not going up this time, but coming down. Would it be possible, I mused, to get out with (shudder) *10* watts?

The following day I called a ham in town and asked him for the loan of his old Novice rig. He was very obliging and the rig floated out to me on the next supply boat.



A 6AG7 in working condition for the tube and a clean board for the chassis.

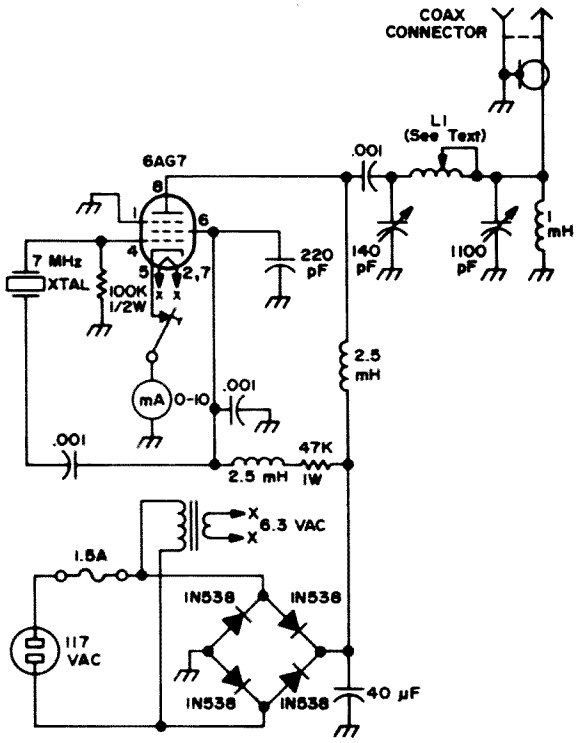


Fig. 1. This "monster" really works. 1.2W input but lots of contacts. This is real QRP.

I set it up and measured the input. Eleven watts – almost. It was close enough! And it was crystal controlled! I put it on the air, and within a week I had accounted for 14 states and 3 countries. What next?

The inspiration took me by surprise. One moment I was moping over the Novice rig and the next I was digging busily through the junkbox, pulling out likely looking components for a rig to end all rigs (and maybe all QSOs too).

Could I, I mused, build a rig using one receiver tube and junk parts of the TV variety? Could I nail them all to an old board and still make a contact? Could I?

Well, a 6AG7 in working condition was the tube, and a clean old board the chassis. I could not find a transformer anywhere, so line voltage would have to do. I did find a filament transformer after a mighty search. I was really sweating the vision of a big bank of resistors or a long string of do-nothing tubes to drop the line to 6.3V.

All went well and Fig. 1 shows the result of my labors in low-class circuit design. Some of the component values I figured out by use of formula but, as many have found, it just doesn't want to work that way. So I was forced to resort to put-it-in-and-try-it techniques. If you have a grid dip meter around you've got half of it licked right there.

The rig is a funny sort of Pierce oscillator and amplifier all in one metal-cased tube. I put in a pi network to match the 50Ω transmission line impedance. The key and meter are in the cathode lead (she'll chirp like a bird, I thought).

The tank coil is a wonder. You can't help but wonder why it is so big. Why would anyone in his right mind want to put a 500W coil in a 500 mW rig? Well, it seems that in the junk heap I came across this nice shining 12-gage wire; and since I didn't have any small coil forms anyway, what the heck! I spaced its 11 turns with hunks of rubber so that I came out with about three turns to the inch and a length of about 4 in. I rolled it on a partly empty roll of Teletype paper so the diameter just happened to come out to 3½ in. I drilled holes in the side of my wooden chassis and hammered the ends of this little beauty into them so it is mounted nicely on the side of the rig. An alligator clip provides for tuning but as it turned out, the coil works best without any of it shorted.

This monster really works. The tube runs at 150V and 8 mA when dipped (10 mA not dipped). This figures out to about 1.2W input and, considering the efficient design, I would imagine about 500 mW or below ever sees its way to the antenna. It is barely enough to move the pointer on my swr bridge more than half an increment – and you have to look closely to see it move!

When the plate is dipped carefully there is no chirp, and the rig puts out a fairly clean signal. Because I am keying the oscillator, I always monitor with the receiver to make sure there is no chirp or frequency drift.

After a week of operation on 40m with a dipole 10 ft up, the rig turned in great reports from everywhere. So what next? I wonder how a souped-up version of the 2N107 would work out?

...KL7FSX■

F. G. Rayer G3OGR
Longdon Heath
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Worcester, England

20-60w 1-4 BAND TX

It is indeed easy to build a transmitter which will run 20–60W on 7, 14, 21, or 28 MHz with excellent efficiency. Figure 1 is the circuit, and this is so well proved that it would be difficult to find any snags; and the constructional work could scarcely daunt anyone. Probably few other circuits can give so much with so little complication. You can even connect a modulator if you like – either for screen grid, or both plate and screen (high-level) voice working.

The 5673 is a crystal oscillator able to provide output on the crystal frequency, or multiples of this. As an example, a 7 MHz crystal will allow working on 7, 14, and 21. This type of oscillator is astonishingly easy to get going.

L1 is the plate coil, tuned by C1. L1 is for the band on which output is required from the transmitter, so that the power amplifier works straight through on all frequencies. The final is a 6146, and running up to 100 mA at 600V (60W input), it is well within its ratings. As a 6146 can easily cook itself with its own juice off-tune or without bias, and bias is obtained by grid current through R3, a 5

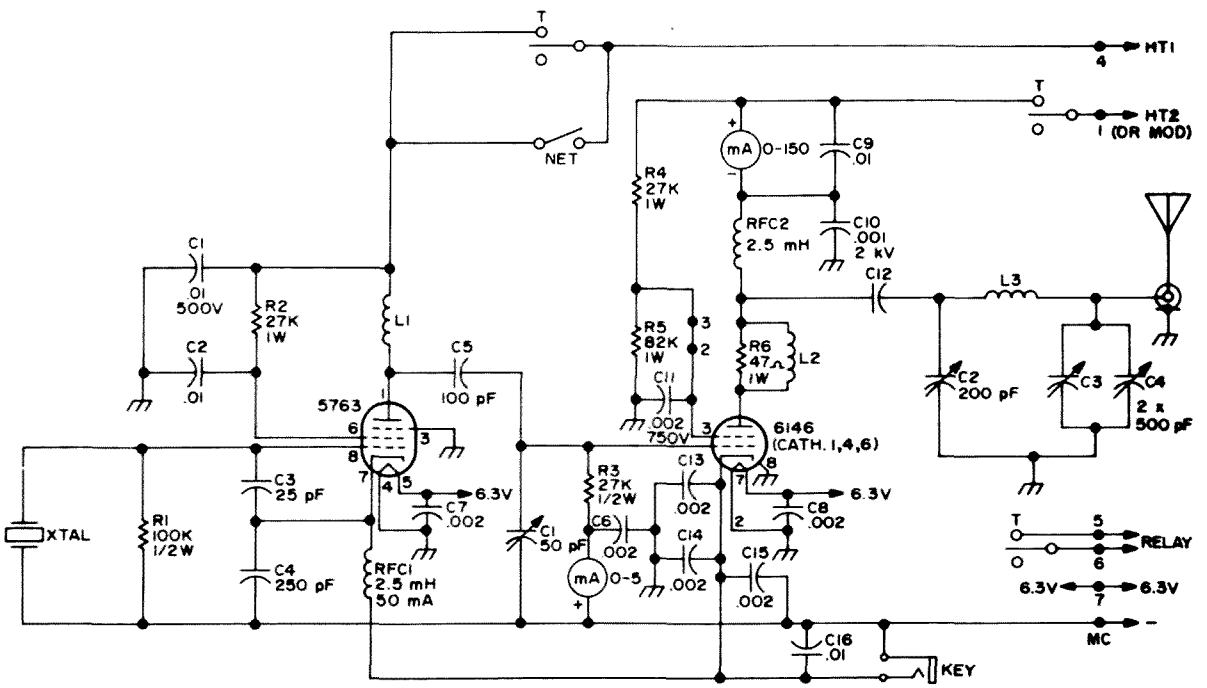


TABLE I–DATA				
BAND	DIAMETER	NO. OF TURNS	GAUGE	LENGTH
7–L1	1/2 in.	40	24	—
L3	1-1/4 in.	22	18	2 in.
14–L1	1/2 in.	20	24	—
L3	1-3/4 in.	10	16	1-1/8 in.
21–L1	1/2 in.	9	22	—
L3	1 in.	11	16	1-1/4 in.
28–L1	1/2 in.	9	22	—
L3	1-1/4 in.	5	14	1 in.
NOTE – L1 ALWAYS HAS TURNS SIDE BY SIDE				

Fig. 1. Circuit of 1–4 band transmitter.

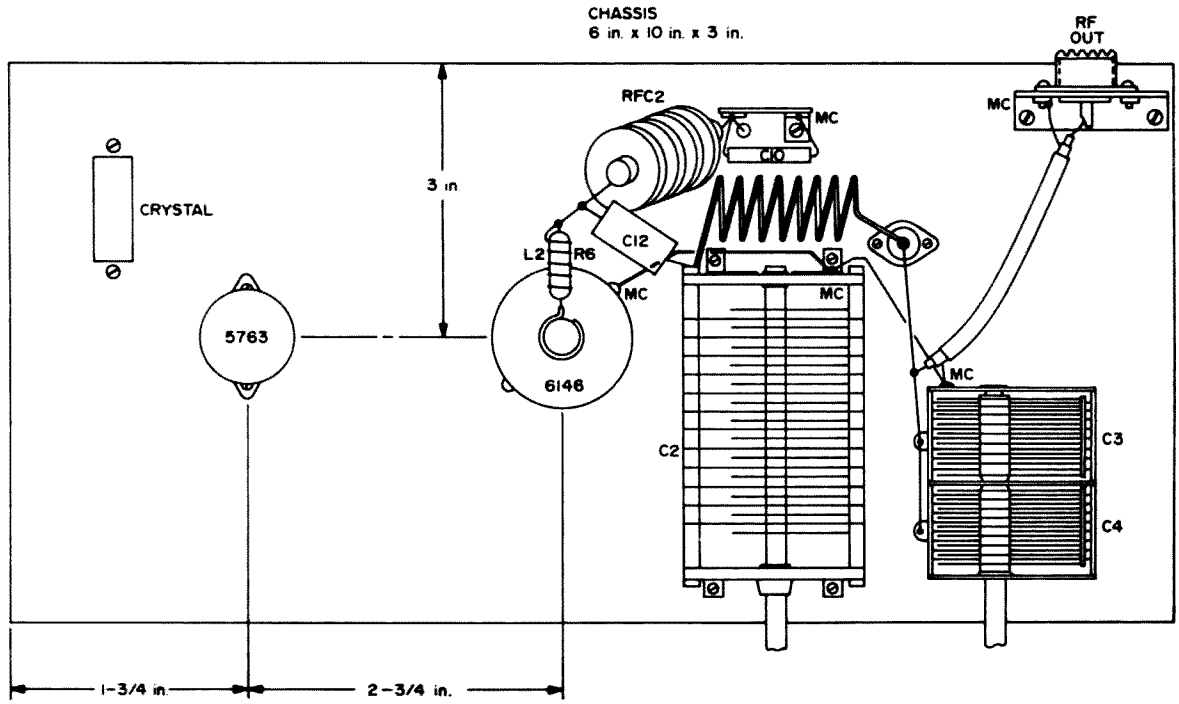


Fig. 2. On top of the chassis.

mA meter monitors grid current. So on any band, you simply tune C1 for about 2 mA grid current, giving about 54–65V grid bias.

After the parasitic suppressor (L2/R6), rf reaches the pi tank L3, with power amplifier tuning capacitor C2, and output capacitor CE–4. This will match into a dipole and useful range of other impedances.

Keying is via both cathodes, giving complete cutoff with the key up. R5 and R7 are to keep screen-grid and cathode voltages within limits with the key up. With the key unplugged, the key jack closes, for tuneup of grid current or amplitude modulation working. Closing the NET switch puts B+ on the 5763 only. This gives an indication of the crystal frequency with the receiver, and will also allow tuning for grid current.

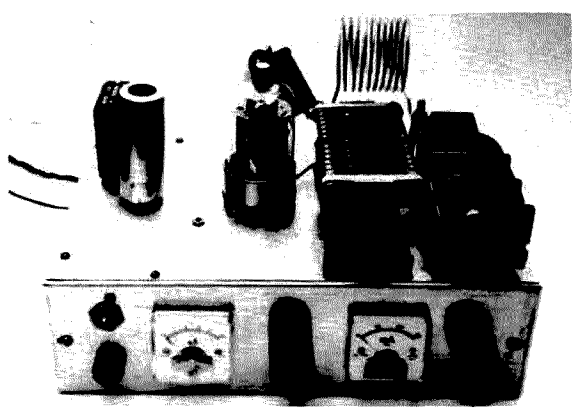
When the transmit/receive switch is at transmit, B+ reaches both stages. Turning this switch to receive takes B+ off. Spare contacts can operate the antenna changeover relay. This is useful for phone contacts because this switch can control modulator B+, transmitter, antenna, and receiver muting circuits through a relay.

Building It

A chassis 10x6x3 in. seems suitable, with pi tank and other output components on top (Fig. 2). To obtain a short rf return, a stout lead joins rotor tabs of C2 and C3/4 together, and to a tab at the 6146 holder.

The meters, C1, Net switch, T/R switch, and key jack fit on the front runner. Figure 3 is the underchassis.

Leads not intended to carry rf (those to heaters, B+ circuits, key jack and meters) run against the chassis. Bypass capacitors go directly from the holder terminals to the chassis lugs. In particular, have very



Chassis carries grid and plate meters on front. The 6146 PA runs 20–60W input.

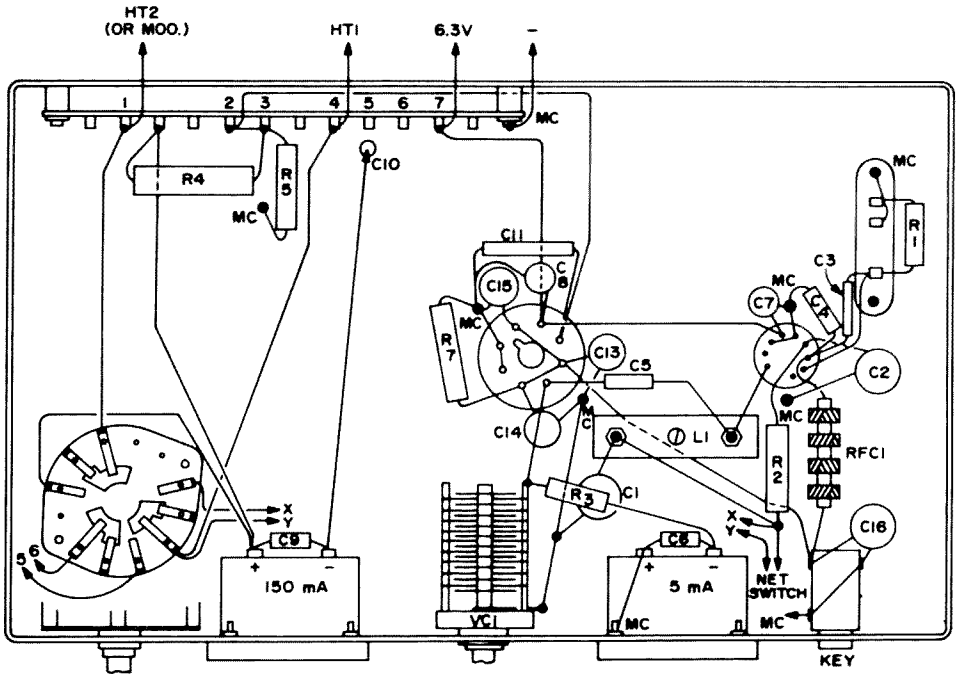
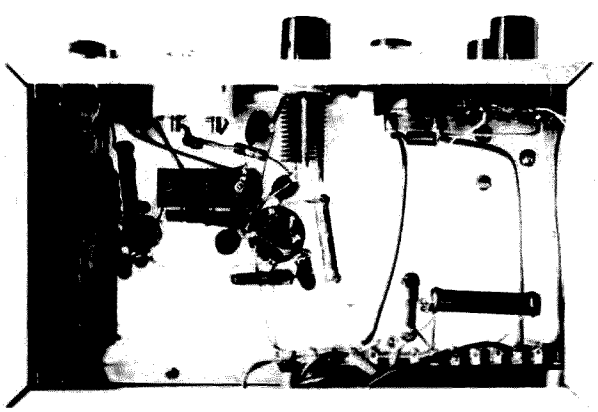


Fig. 3. Under the chassis.

short leads from the 6146 to C13, C14, C15, and C11, and to chassis.

The B+ circuits must be well insulated, especially for the higher voltage. Should you practice high-level modulation of the 6146 with a 600V supply, the peak B+ swing will be 1.2 kV; hence, the need for insulation for this voltage, and the use of high-voltage reliable mica capacitors for C10 and C12.

A terminal strip anchors power and other leads (Fig. 3). For high-level modulation, bring modulated B+ to terminal 1. The modulator should give about 30W of audio, for 60W power amplifier input. To modulate the screen grid, the single 6BW6 or similar output stage will do. Remove the jumper between terminals 2 and 3. Modulate at terminal 2. Be sure switching cannot apply screen-grid voltage when B+ is not on the other circuits.



Underneath. The 5763 oscillator coil attaches to two bolts on insulated strip for bandchanging.

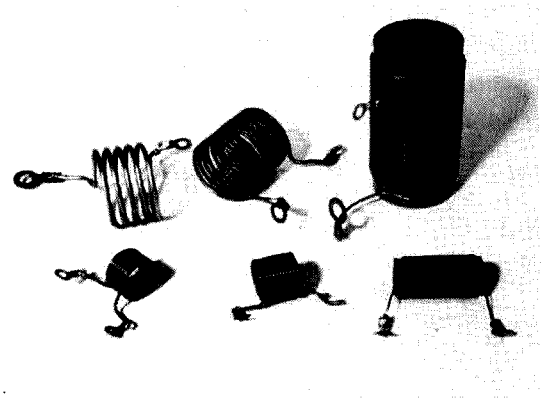
Power Requirements

The heaters need 2A at 6.3V. The 5763 crystal oscillator will work with about 200–300V. It draws 30 mA at 300V. A separate receiver type power supply is good for this stage, though it is possible to work with a single supply for both stages.

The 6146 supply may depend on what is available. Good results at a lower input rating are obtained with 300–400V, though 500–600V will naturally give more input and output power.

Though any usual supply is practical, the best type will have a choke input from the rectifier, with bleeder current consumed by a resistor across the B+ line. Then the voltage will not soar during intervals when the transmitter is not drawing current.

A capacitor-input power pack gives more voltage from a particular transformer secondary, but unless quite a heavy bleeder current can be spared, the voltage rises badly "off load."



Oscillator and output tank coils for 28, 21 and 7 MHz. Pair of coils for 14 MHz are on transmitter.

Inductors

L2 is 5 turns of 18-gage, 3/8 in. outside diameter and 5/8 in. long, with R6 inside. L1 and L3 are fitted in pairs. Changing them simply needs four nuts to be removed. This lets you work one band if that is all you want, or use other bands if you wish.

Coils for L1 can be close-wound on insulated tubing, or self-supporting for 28 and 21 MHz. If turns are as in Table I, wrong harmonics are not likely to be tuned. It is as well to check the band tuned by L1 with an absorption wavemeter, which will cause a dip in grid current (shown by the transmitter grid meter).

L3 tank coils are self-supporting for the HF bands. Though the 6146 will double, this is bad practice. So L1, and grid drive, is always on the wanted output frequency.

Operating Procedure

Those crystals which multiply up into the wanted part of a band can be used where they provide enough grid current. So some low-band crystals will allow working on one or more HF bands as well. As an example, a 3.55 MHz crystal will do for this frequency, and also 7.1 MHz. Similarly, a 7.05 MHz rock would do for 7.05, 14.1 and 21.15 MHz. A 3.5 MHz crystal gave better than 4 mA grid current on 14 MHz, and a 7 MHz crystal about 4 mA on 21 MHz. Grid current is greater at the fundamental, or with only 2X multiplication.

Always tune for at least 2 mA grid current,with the NET switch putting B+ on the oscillator only. If enough grid current is not obtained, the crystal is unsuitable. A 3.5 MHz crystal will not give enough output on 21 or 28 MHz.

A 60W domestic lamp as load will check rf output from the transmitter, but not for keying, due to changes in cold and hot resistance. For this, a 75Ω dummy load can be connected.

Close C3/4. Tune for grid current. Open the NET switch. Switch to transmit and immediately tune C2 for minimum current as shown by the meter. Increase B+ input by opening C3/4 while readjusting C2 for the HT dip. As this proceeds, plate current will rise, and the lamp will light with good brilliance.

Check grid current as necessary, readjusting C1. The 6146 is not neutralized, and tuning its plate circuit causes some change in grid current, especially on the higher frequencies. This has no great effect on results, as grid current is always seen and easily adjusted.

When loading the transmitter to an antenna, tuning up can be as described. A dipole cut for the wanted band is probably a good antenna with which to start. With other types, if adjustment of C3/4 does not allow satisfactory loading, then the antenna impedance is outside the range of the transmitter. The best solution is to add a match box.

The 6146 should not be left operating in conditions in which it has a high dc input, but little rf output, because the power is then dissipated *inside* the tube. This is avoided by always having at least 2 mA grid current, and dipping C2 for minimum B+.

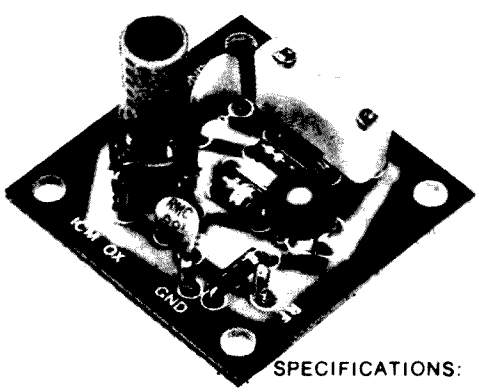
To use a vfo, remove the crystal and C3. C4 can be 0.002 μF. Take the vfo output through a screened coax lead to the 6763 grid. Plugs in the crystal sockets will do this and ground the coax shield at the transmitter. It is usually best to apply drive at a frequency which lets the 5763 multiply. For example, at 7 MHz for 14 and 21. A two-stage vfo with fundamental operation on 1.75 and 7 MHz was found to do for all bands, 3.5 to 28 MHz.

. . .G3OGR■

Bill Hoisington K1CLL
Far Over Farm
Peterborough NH

JUST LOOK AT WHAT YOU CAN DO WITH THOSE LITTLE INTERNATIONAL CRYSTAL KITS!

Since I have been building some kind of solid-state unit such as an i-f amplifier, an rf power stage, a solid-state X-band oscillator, etc., at an average of about one a week, I appreciate an organization that is marketing kits for us amateurs in a sensible fashion. Frankly the prices don't appear sensible, being much, much too low! For $2.95 you get a complete crystal oscillator kit (3–60 MHz). You don't get the crystal at that price, but you do get the transistor, and the oscillator works right off the bat.



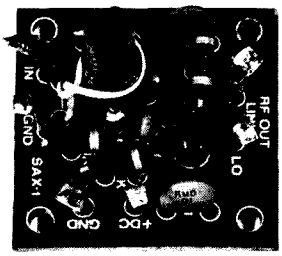
You can follow the oscillator with an rf power amplifier for $3.75 that puts out 200 mW up to 30 MHz and will light a pilot lamp brightly. Any time you can light a bulb you can have QSO's. With a 201A and 90 volts of B battery I used to work all up and down the East Coast every night. Of course I was in Bermuda, parked just *outside* the American band, and it was 1925. I'll bet it can still be done today.

The nice thing with these kits is that you can put them on the front seat, either with dry cells or the car battery and drive up on any hill, put a small beam on top of the car, and away you go. Don't just go up there with a halo or a whip, please! Try something with a little more sock to it. Battery operation plus a hill plus VHF equals DX.

SPECIFICATIONS:

1. Frequency Range	LO—3000 KHz to 19999 KHz HI—20000 KHz to 60000 KHz
2. RF Output	.2 volts rms into 50 ohms (min)
3. DC Power Required	6 volts at 20 ma (operates 4 to 9 volts)
4. Frequency Tolerance with OX and EX Crystal	.02%
5. Operating Temperature Range	0 to 50 Degrees Centigrade
6. Frequency Change with 1 Volt Supply Change	.001% (max)
7. Output Level Change with 1 Volt Supply Change	2 DB (approx)
8. Size	1½" x 1½" x 1¼"
9. Mounting	4 holes with spacers or fits over 1¼" chassis hole
Complete Kit (less crystal)	**$2.95**

Fig. 1. OX oscillator kit specs.



OX-oscillator

You probably know by now that my fun begins on six meters and goes on up, so I'm mostly talking 50 MHz to start with. If I did try one of those little rigs on 40 or 20 who knows what I could work?

The OX Oscillator Kit.

There is a certain fascination about these little kits that grows on you. It could be due to the absence of cerebration needed, something like a vacation for me, as most of the work I do on this well-worn bench does require at least a little.

When you get the kits you receive a four-page instruction folder with good, simple dope and the circuit. You also get a very neat little copper-clad phenolic board which not only has the actual circuit on the copper side, but clear and well-printed names of the components on the other side. It is *almost* impossible to go wrong. I did. If I had read every word on that little four-page sheet I would have been fine, but I hurried a little too much. There is a just slightly tricky spot if you don't read it all over carefully. This is where it says on page 2, "the remaining parts (R, L, and C) are selected according to the frequency range from the chart below." What they mean is that this particular selection is done at the parts packing stage in Oklahoma City. And it was done exactly right for the "OX-HI" kit I ordered. Just read every word and think it out with the aid of the board and the schematic and you won't go wrong. Also check all the parts in the bag, recheck with the circuit on page 4, and you'll have it correct the first time.

Be sure of this, because it is *not* handy to replace or change parts that are soldered in place. Plan to do any experimentation *outside* the board.

As soon as I got those little parts "selected according to frequency" installed (my fault entirely on that one) and threw the battery switch, bingo, 3V dc output on the meter of my trusty old 25 to 75 MHz tuned diode receiver-rf meter.

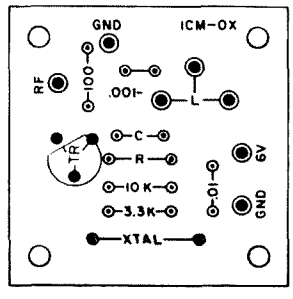
One actual omission in the instructions did show up. I've just read everything over again once more to be sure this one wasn't my fault also. Several loose connections showed up as intermittent oscillation, and these were in "the connector pins that have been staked into the board at the factory" department. As soon as I *soldered* them onto the copper circuit, operation was steady as a rock and has been since then.

The instructions are pruned down to exactly the minimum possible number of words and still get the correct ideas over. The exact quantity of all the parts needed, including "1 jumper wire, No. 24, 1½ in."

The circuit , as can be seen in Fig. 2, has everything you need. It will be interesting to see just how far you can go up in frequency and power using these little planks exactly as they are.

Planned Systems

My first intention is to build up a complete six meter rig similar to my faithful



OX Hole Layout

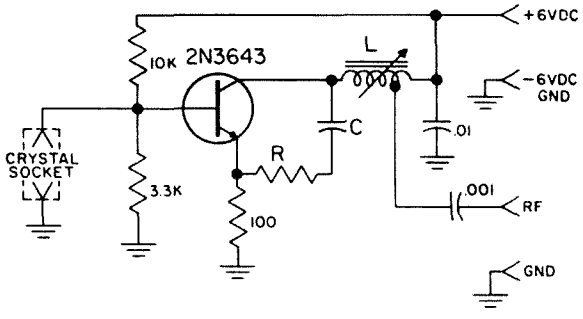


Fig. 2. Layout and schematic, OX-oscillator.

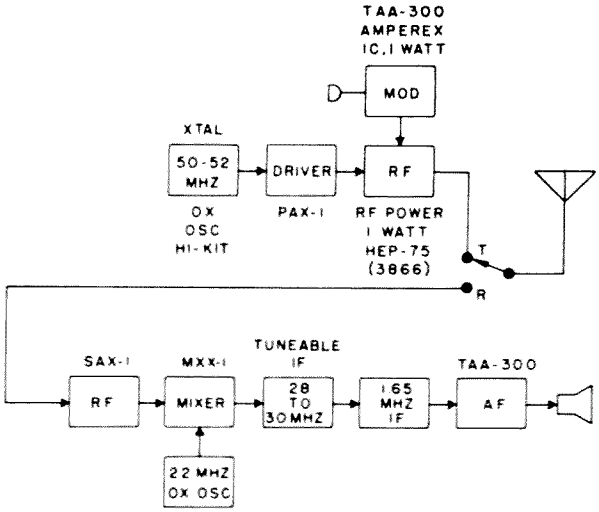


Fig. 3. Diagram subject to revision

old Gonset Three (Fig. 3). The biggest mistake I ever made in radio work was to sell that unit. Plugged into the ac at home or into the 12V battery in the car, mobile or mountain top, I could listen to all the lads on the air and could contact them. So maybe now I'll have a solid state replacement for it. I sure hope so.

There is a slight hiatus coming up though, because the power amplifier kit, PAX-1, says it only goes to 30 MHz. There is also the broadband kit, the BAX-1, to work with, which claims to go to 150 MHz with 6 dB gain (it does).

The receiver should go well with the small signal amplifier, mixer, and oscillator kits. There doesn't seem to be any frequency-multiplier kit. How come? Maybe the BAX-1 will triple? It will probably do well as an i-f amplifier also. Plenty to do, as you can see.

The Broadband Kit, BAX-1

This little gem (they're only 1½ x 1½ in.) was tried with the 50.5 MHz input from the OX oscillator kit. No good. Like the instruction sheet said, it is limited. I should confess right here and now that I'm not exactly a broadband type. With a scope a broadband amplifier is not only good, it's a necessity. And this little plank does amplify small signals, and well, too. I checked it out with my signal generator and it really does amplify, several hundred times, just as they claim. I'm sure going to try it out in the i-f stages when I come to that part of the receiver for the complete six meter rig.

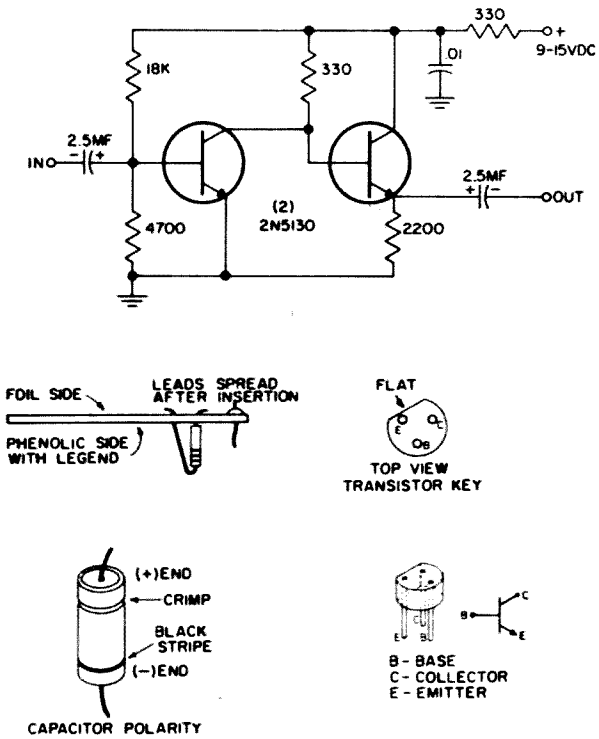


Fig. 4. Broadband amplifier BAX-1.

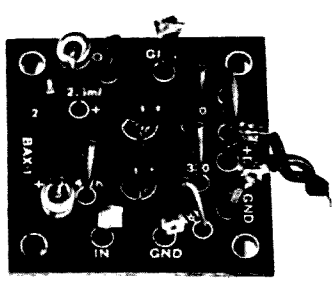
They ought to say whether or not there is any nuisance feedback in it for such an application. This is the thing called "reverse transadmittance" by the engineers in charge of such things in big companies.

I might add that it took me less than an hour to solder in the parts and have it working.

When you consider that it does amplify whatever signal you put into it, over a tremendous range, without inductors and without tuning, it's quite a nice little unit. I'm sure I will find a use for it soon, other than as an i-f.

The rf Power Stage on Six

Since International Crystal did not have an output stage on six, I threw a Motorola

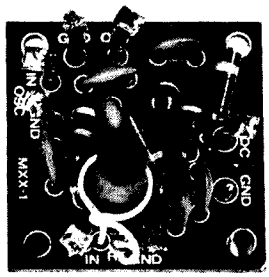


BAX-1

transistor, the HEP 55 at only $1.20 amateur net, into the breach, and it took off like a little black plastic bandit on 50.5 MHz. Figure 5 shows the circuit, breadboard style, driven by the OX crystal oscillator exactly as is! Figure 7 shows the layout.

The OX oscillator on 50.5, one of the crystals I picked out, has a low impedance output tap so this was fed directly into the HEP55 base, through a couple of feet of RG8/U, two "phono" plugs, and J1, into a .001 capacitor, to preserve the base's dc bias. The base is fed dc through a 1K resistor, which I prefer to a choke because there is less chance of self-oscillation. So far none has appeared, so leave well enough alone!

The low value final emitter resistor was "snuck up on" in the usual fashion em-



"MXX-1" Transistor rf mixer

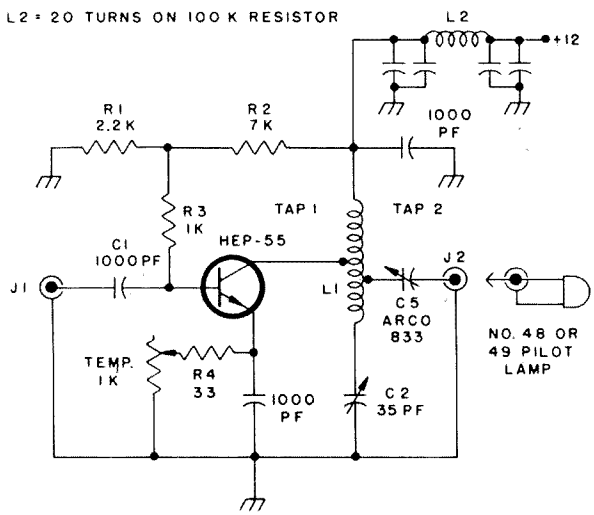


Fig. 5. Motorola HEP55 six meter amplifier. L1 = 12 turns, airwound, 6 per inch, 5/8 O.D. Tap 1 = 5 turns from cold end. Tap 2 = 6 turns from cold end.

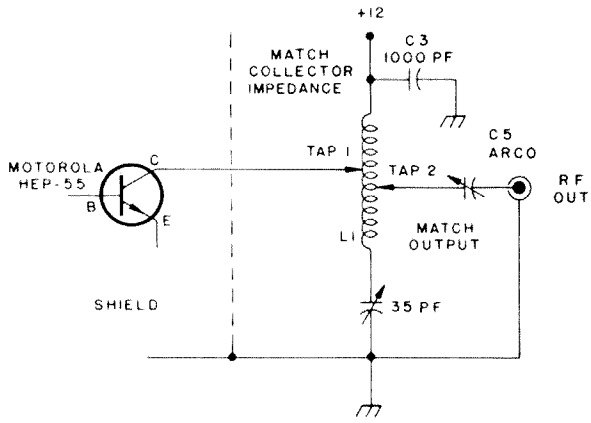


Fig. 6. Collector and output maching.

ployed here, a 33Ω series limiting resistor, along with a temporary 500Ω pot. When everything is tuned up and properly matched and loaded, but not before, you can tie the 33Ω resistor down to ground and leave out the 500Ω pot. Until that happy all matched point is reached, the rf output will tend to drop off with less than 100Ω or so. You'll see what I mean as soon as you try it.

The collector tap as well as the output tap was determined by the "empirical" method, otherwise known as "cut and try."

You should see the complicated equations indulged in by various types of engineers to get rf circuits running today! After ten pages of this stuff they announce, "The circuit was then built and tested." Results count, so don't be scared off. The above circuit using the OX oscillator drive as mentioned puts out 180–190 mW on six, from a $1.20 transistor. After all the HEP55 is only rated at 310 mW dissipation. The dc used was 15V and the mils 25, for 375 mW dc power, and thus a little over 50% efficiency on 50 MHz. What more do you want?

Figure 6 shows details of the breadboard tuning up method for the collector and the output circuit taps, which handled perfectly. As the collector was brought nearer the cold end and tuning became sharper, and the power rose. The output matching is done with a tap and a series capacitor to match the number 49 or 48 bulb impedance at six meters.

This match may change a little for use with a 50Ω cable going to a beam, but for now it loads the final in good style, for either overloading or underloading or just right for 180 mW to the No. 48 bulb.

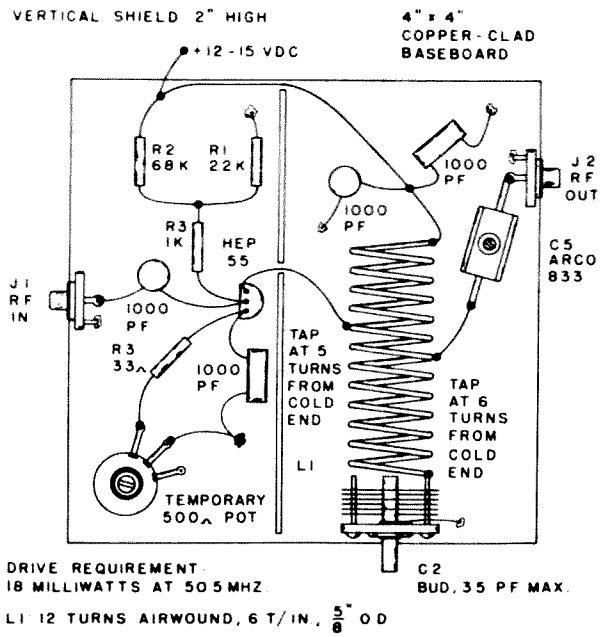


Fig. 7. Layout, six meter, HEP55 power amplifier.

Note that when you have maximum output with the desired loading and tuning, you will also have a good match. They go together like peaches and cream. This does *not* mean the maximum without varying both taps 1 and 2, referring to Fig. 6. It *does* mean that when both taps, tuning, collector loading and current, have been run through in combination several times and no more gain and power out can be obtained, *then* you are matched.

Pushing the OX Oscillator (Just a little!)

Busy tuning up the HEP55 final I noticed that the output of the OX crystal job, when pushing it along with 9V (sometimes 10 or 11 I'll admit) seemed almost enough to light a bulb, but I couldn't quite see a glow, even with the lights out. This is the good old 2V-60 mil pilot light No. 48 screw base type, or the 49 bayonet type, which starts to glow a dull red around 17 or 18 mW. So, after swearing that I would not touch that gem of a circuit by ICM, I gave in and lowered the emitter resistor a shade. See Fig. 2. It only needed just a touch, like down to around 75 Ω to light that bulb. When I can *see* the rf I feel much better.

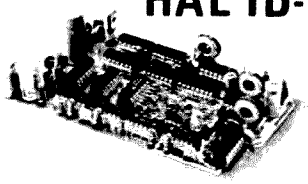
A little later I tuned up the "L" better with the slug and found that I could light the bulb with the exact circuit of Fig. 2 without changing the 200Ω resistor. I also find that I have about 11V dc on it. ICM says 4 to 10, so maybe that's a little too much. After all, if you want more power, add a power stage, which is of course just what the HEP55 is in there doing, so don't push that one tiny little oscillator transistor off the shelf!

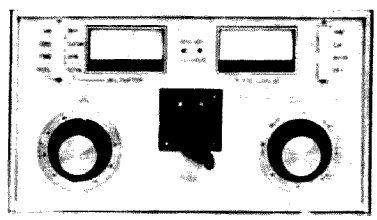
Conclusion

Everything going fine so far . . . next comes modulation, size reduction, then the receiver, a mobile six meter beam idea, and then a little mountain topping to try the rig out.

Lots of interesting extras can be dreamed up for this one, too, like; A, adding a Motorola HEP75, which is their version of the famous 2N3866 for only $2.95, "suggested net," with a 3 to 5W dc input capability that works good at 432 so no knowing what it will do at six, but I'll soon find out; B, a low noise input rf stage; and C, a narrowband i-f following.

. . .K1CLL

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"My advertising money was absolutely wasted!" That's what one manufacturer who tried ads in all four ham magazines told us about the results he got from one old and well-known magazine. This chap, trying to launch a new product of interest to VHF men and home builders, had no money to waste on advertising that didn't pay for itself and could ill-afford a setback like that. You'll find his ad running in this issue . . . 73 paid off for him and paid off well . . . the others didn't! The results elsewhere ran from "absolutely worthless" to "didn't pay for itself."

This chap is lucky, in a way, because he is selling his products by direct mail and he found out immediately which magazine was selling for him and which was just using up his valuable capital, slowly running him out of business. Pity the larger manufacturers who buy their ads on the basis of how old a magazine is, how much gall the publisher has at circulation swearing time, or how much of a discount they can get from the regular rates. He passes along this tremendous waste of money to his customers in higher prices and then wonders where the profits went.

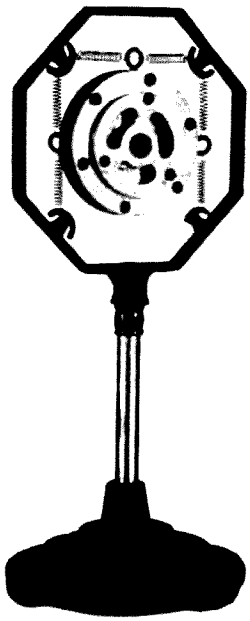
Does it make any sense that 73 readers buy more ham gear than the readers of the other magazines? Just think over the general slant of the four ham magazines for a moment and see which seems most slanted toward the probable active and buying amateur. How about one aimed at kids and certificate hunters? Will they be good buying customers? Will a magazine aimed at conservative old-timers be a rouser at the cash register? How about one that interests engineering-type home builders marching to the tune of "build, don't buy!"

Only 73 is edited and published by an active amateur . . . a ham who is on the air daily and who has worked with enough different aspects of the hobby to write books on several of them . . . a ham who has represented the U.S. at Geneva at the I.T.U. . . . a ham with over 30 years of hamming behind him. Only 73 has a sense of humor, realizing that amateur radio is a hobby and is for fun . . . as soon as the fun goes out of it the hobby will die. Only 73 carries the ball when new developments turn up . . . 73 pushed sideband when it was new . . . pioneered transistors years before the other magazines . . . pioneered ICs . . . pioneered RTTY . . . pioneered ATV . . . and now is publishing more FM info than all other ham magazines combined, times two . . . and watch 73 for SSTV developments! Only 73 has newspages for the non-technical amateurs so they can keep up with current amateur events.

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W. Edmund Hood W2FEZ
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The Saga of Mikes and Earphones

Late in the 1870s, a Boston inventor was so stunned by Bell's creation of the telephone that he suffered with insomnia for a whole week. "If Bell had known any more about electricity," he fumed, "he could never have invented the telephone." In one sense he was right. Electrical knowledge of the day was restricted to make-and-break devices. Strict obedience to what in that day was thought to be hard and fast rules would have rendered telephones absolutely impossible. As is generally the case in the birth of any major device, Bell was not primarily an electrician, and so was not hampered by convention.Bell knew one thing, however, that the electricians of his day did not know. That was the exact nature of human speech. His father had been an expert in the subject before him. Moreover, Bell had actually made tracings of the vibrations of speech by connecting a diaphragm to a movable pen which rested on a paper strip. He knew what to shoot for before he started, a current which could vary exactly as the air pressure varied when transmitting sound waves.

The big idea came to him through a lucky accident while working on a multiple telegraph system. A series of metal strips, each tuned to vibrate at a different frequency, would be set into motion in the field of an electromagnet and caused a similarly tuned strip to vibrate at the other end. Bell's assistant, Thomas Watson, was having difficulty at the transmitting end. His struggling with a jammed reed set up a racket in the receiver which Bell was smart enough to interpret. "Don't change a thing!" he shouted to the startled Watson, and began scrutinizing the apparatus. The infant idea was developed and a a patent granted nine months' later. Bell's first telephone consisted of a diaphragm which vibrated a piece of soft iron within the flux of an electromagnet. The changing flux allowed the current flowing through the electromagnet to undulate. It worked, although very faintly. Bell also tried attaching the diaphragm to a rod immersed in a container of acid. The vibrations of the diaphragm moved the rod in and out of the conducting acid. A battery connected in series with it saw an undulating resistance, therefore, an undulating current. It was over this monster that the famous distress cry ("Mr. Watson, come here. I want you.") was delivered. Bell had spilled some acid and was in pain from it. Now Bell was not an American citizen at the time, and so he did not have the option of filing a *caveat*, or declaration of intention to invent the device.

He had to patent a working invention or forget it. Two hours after his patent had been entered on Bell's behalf by his future father-in-law, another inventor filed a caveat for an almost identical device. Elisha Gray did not invent the telephone at the same time as is commonly believed. He merely served notice of his *intention* to do so. In fact, Gray was later part of a committee that honored Bell, and quite glad to do so.

It's a sad thing to note, but in that day it was common for one company to pirate the rights of another and try to beat it in the courts by bribery or by out-and-out fraud. Bell found himself pitted against some of the largest corporations of his day, and, at one point, he had to fight it out with an ex-governor, a number of congressmen, and the United States Attorney General. This kind of piracy was unusual in only one way. Bell won.

With the introduction of the telephone to the public, Western Union interests nearly panicked, and for several years there was quite a bitter feud between the two. Bell and Western Union pirated one another freely. To compete with the telephone, Western Union had hired a clever young man named Thomas Edison. Edison replaced the electromagnet with a container of carbon granules. The varying pressure of the sound waves on the diaphragm caused the resistance of the carbon granules to vary. Edison's microphone was far more sensitive than Bell's. Bell used Edison's mike while Western Union used Bell's earphone. Nothing like reciprocal piracy, is there?

The battle between the two raged both in the U.S. and abroad. In England, the British patent office forbade Western Union from using Bell's earphone. Edison's patent on the microphone was useless by then since a man named Berliner had, after fourteen years of litigation, managed to prove that he had invented the same thing before Edison. He finally got patent rights, although Edison still had rights to his model. Berliner sold his patent to Bell. In England, then, both parties could use the carbon microphone, but only Bell could use the earphone.

The British rivals of Bell's company frantically cabled Edison. "Hang on," the inventor replied, and went to work on it. The answer came in the form of an "electromotograph." This forgotten child of Edison's genius consisted of a rotating chalk roller which kept a tension on the end of a rod. The rod was connected to the diaphragm. A sponge kept the roller wet. Edison had discovered that the slipperiness of wet chalk would change when electric current passed through it. As the slipperiness of the chalk roller varied, so did the tension of the diaphragm, and the diaphragm vibrated. The electromotograph had originally been invented for another application, and here it still had a lot of bugs, but it worked well enough to get a patent.

Finally, Western Union and Bell merged. The Western Electric company was formed to construct telephone equipment, and for a number of years it had a monopoly on communications. Then came radio. In 1906, Dr. Ernest Fessendon made his first radiotelephone transmission, and startled the entire world. By the end of World War I, radio was becoming more and more available to the public. KDKA, which, by the way, had begun as an amateur station, started the first scheduled broadcasting and the rush was on.

Carbon buttons were the first microphones used in broadcasting, which is natural enough, since they were the only kind available. But carbon buttons have their disadvantages. Frequency response is restricted. Also, the necessary current offers a high noise level. First to be attacked was the frequency response. Western Electric used a stretched diaphragm to raise the resonant frequency

This meant lower output, but that was no problem. It was partly compensated by using a carbon button on either side of the diaphragm. For a few years the double button carbon mike was the standard symbol of broadcasting.

Western Electric kept a firm grip on the patent rights to the stretched diaphragm microphone until, in Watertown, Mass., Delano Co. started making them. It was a small company, and Western Electric sued. Their strongest point was the stretched diaphragm raising the resonant frequency.

Delano showed that the African savages, for years, had been stretching the diaphragms of their drumheads for the same effect. He won the case.

At the receiving end, the electromagnetic earphone had been there right from the beginning. It was, after all, a fundamental thing. To this day, it's still essentially the same instrument Bell invented. When radio became a public medium, manufacturers simply put a large horn on the output of the earphone, something like a megaphone. In the mid-20s Nathaniel Baldwin attached a diaphragm to a lever which, in turn, was connected to the earphone diaphragm. By simple lever action it magnified the motion, thereby giving a louder sound.

In the late 20s, scientists found an answer to the biggest drawback of the carbon microphone. The current through the mike caused a very high noise level – so high, in fact, that a whisper or a soft voice was simply lost in the mud. (Incidentally, this defect was responsible for the downfall of a lot of the stars of silent movies as "talkies" came into vogue.) Clearly the need was for a microphone that would have a low noise level.

The answer came in the form of the condenser microphone. The vibrating diaphragm would cause a capacity change between it and a back-plate a few thousandths of an inch away. A high voltage was connected across the capacitor, and as the capacity changed due to the varying spacing between the diaphragm and the back-plate, it would alternately gain and lose charge. Consequently, a minute alternating current would be present which exactly followed the audio. This current was detected in the form of a voltage drop across a series resistor. The output was so low that two or three amplifier stages had to be built right into the case. Nonetheless, the condenser microphone was and still is unsurpassed for fidelity and frequency response. It was put into wide use around 1934 when NBC started broadcasting.

In the meantime, loudspeakers were introduced by Jensen. The Jensen unit was an electromagnetic dynamic driver feeding a horn, and first saw light of day in the early 20s. Loudspeakers such as we know them were introduced in the late 20s as the paper cone replaced the horn. The magnet was an electromagnet until the mid-30s with the introduction of Alnico. Electromagnetic speakers remained in use for quite a while, however. I can remember seeing them in the early 50's as I took apart old radio sets. I recall that one of the more popular means of exciting the electromagnet was to use it as a filter choke in the power supply circuit.

Until the condenser microphone was introduced, Western Electric was without competition. Then they suddenly found themselves competing with a microphone that was much better suited for broadcasting. They responded with the dynamic microphone, which had a good frequency response, low noise level, and a high output. It was also far less sensitive to moisture than the condenser microphone, and needed no high voltage power supply.

About the same year as the condenser microphone was invented, an engineer at RCA named Harry Olsen produced still another microphone. This one used a thin metallic ribbon suspended between the poles of a magnet. It was the velocity of the sound waves that actuated it, rather than the pressure. While the output of the velocity microphone was lower than that of the dynamic, it had a wide, flat response.

The microphones were manufactured with two ribbon elements at right angles to one another. By connecting them in or out of phase you could alter the directional pickup pattern. This helped the broadcasters to get by one very sticky problem. The problem was best expressed in an old cartoon which showed a microphone placed at the head table of a highly publicized banquet. The voice of the guest of honor was being drowned out by the other head table guests who were loudly downing their soup. An exaggeration, maybe, but extraneous noise was a major problem in the early days of broadcast, and a directional pickup was a welcome answer. So much so that the housing of the velocity microphone, in its familiar diamond shape became an unofficial symbol of broadcasting, and still is to this day. . . .W2FEZ

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QUICK AND EASY PNP/NPN TRANSISTOR SORTER

A simple tester that quickly sorts out unknown transistor types (NPN or PNP) and can be used to give an indication of relative gain for each type.

There are numerous sources of bargain transistors, such as surplus computer boards but, invariably, the transistors are marked with production numbers rather than standard 2N numbers. So, one cannot simply look in a handbook to determine the transistor type (NPN or PNP), or any of its operating parameters. Usually, however, the only characteristic of immediate interest is whether the transistor is of a NPN or PNP type, since the transistor is usually intended for experimental usage, or as a "pot-luck" replacement for another transistor in a non-critical circuit. It would be false economy, generally, to search among surplus transistors to find a unit to use in a circuit where a specific transistor is used because of its known and stable gain characteristics, noise characteristics, etc.

The simple tester or sorter described here is designed to simplify the rapid sorting out of PNP or NPN transistors while not causing any damage to the transistor under test when the test voltage polarities are reversed from those applicable to a transistor type. It provides an aural indication when a transistor corresponds to the type to which a test switch is set, so one does not have to interpret meter scales or other displays. The transistor is used in a dynamic circuit so that when the type is found, one can also have confidence that all the transistor junctions are undamaged.

Once one is familiar with the usage of the tester, transistors can be sorted out at the rate of 5–10 a minute. This is quite an improvement over the laborious VOM testing techniques used by many amateurs where one also runs the risk that excessive current flow generated by the VOM can damage the transistor under test.

Circuit

Figure 1 shows the complete circuit of the tester. It is about as simple a circuit as one can imagine, but yet it does the job. The circuit is basically that of an audio oscillator where the split primary transformer winding provides feedback coupling for oscillation. The frequency of oscillation is determined by the transformer characteristics, as well as by the time constant of the RC network in the base lead. The components used for the RC network were carefully chosen so a large value resistor could be used since it limits the base--emitter current flow when that junction is variously biased during the testing of a transistor. If one follows the polarity of the battery terminals to the various transistor terminals, it will be seen that the correct biasing of the transistor junctions (collector-base junction back biased and emitter-base junction forward biased) only

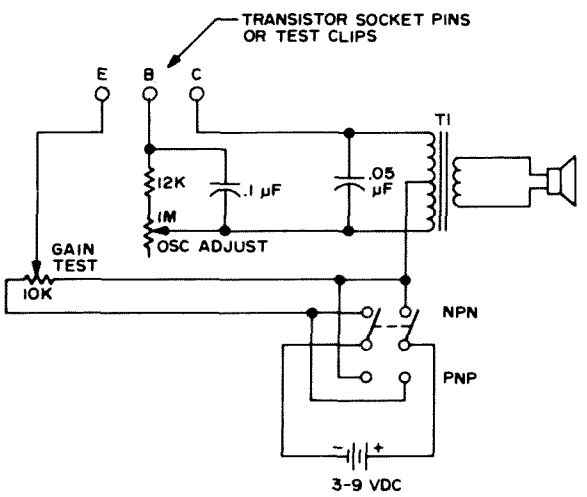


Fig. 1. Diagram of transistor type sorter. "T" is a miniature 400Ω centertapped to 4Ω transistor output transformer costing about 98¢.

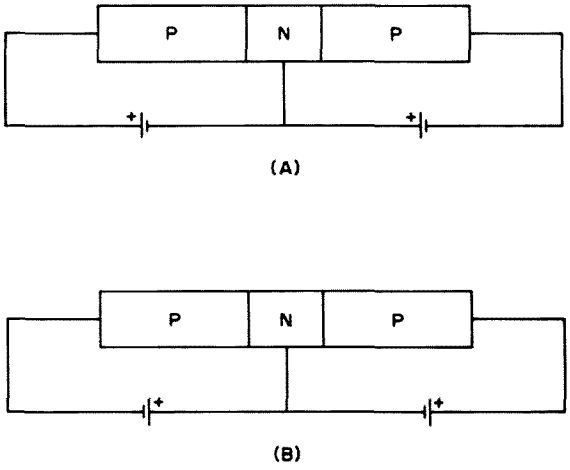


Fig. 2. Junction bias polarities must be correct for a transistor type to oscillate in the test circuit. (A) shows correct arrangement while (B) is false (for a PNP type). Sufficient base lead resistance prevents damage to transistor when improperly biased.

exists when the switch position corresponds to the correct transistor type. Only then will the circuit oscillate. Figure 2 also illustrates this point.

The combination of the low battery voltage used plus the high resistance used in the base lead insures that no damage will result to even a low power transistor during the testing process. We tried deliberately reversing the polarity a number of times on the lowest power plastic case transistor we could find without causing any damage to the unit. This was even done using a 9V battery supply.

The "gain test" potentiometer simply acts as a voltage divider network, so that the supply voltage can be reduced as desired.

Operation

A known transistor should first be used to double check that the circuit functions properly and that the switch positions for NPN and PNP have been properly marked. During this process, the oscillator adjust potentiometer should be set for a roughly 1000–1500 cycle tone. The gain test potentiometer is set for full battery voltage (arm toward left end).

Unknown transistors are then simply tested by connecting them to the tester and noting in which switch position they oscillate. The oscillator tone will vary with transistor type, but this is not important. If a transistor fails to oscillate in either switch position, the oscillator adjust potentiometer should be varied from its reference position, trying each switch position. If the transistor still fails to oscillate, the overwhelming chances are that it is defective and should be discarded.

A crude gain check can be made among a group of similar transistors by noting how much the battery voltage can be reduced, by means of the gain test potentiometer, before the transistor stops oscillating. During this check, however, the oscillator adjust potentiometer must also be adjusted so that oscillation (regardless of frequency) is sustained as long as possible.

Construction

The circuit can simply be breadboarded if only a temporary need exists to sort out a batch of transistors, or it can be packaged nicely into a minibox enclosure as a permanent test unit. In the latter case, if a DPDT switch is used which has a center-off position, it can also function as a power on-off switch for the unit since the gain test potentiometer will drain the battery supply even when a transistor is not being tested.

The idea may come to mind to utilize a code practice oscillator or CW monitor unit already existing as a test unit. Such units can work but one should be sure that the circuit utilized is similar to that shown, particularly with a high value of resistance in the base lead. Circuits with low resistance value voltage *divider* bias network for the base circuit, including most simple RC oscillators, are particularly unsuitable.

The circuit shown has performed extremely well in sorting out transistor types ranging from low power RF amplifier types to surplus digital board types to large power types. Somewhat like a VOM, it soon starts to become an invaluable test instrument for anyone dealing with transistorized equipment since even when transistors are conventionally marked, one does not always have immediately at hand the necessary handbook data to determine transistor types.

...W2EEY■

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Self-Contained Reflected Power and CW Monitor

The average amateur, especially the CW enthusiast, uses only his receiver as a monitor for the outgoing signal from his transmitter. The amateur receiver usually becomes overloaded in this application and does not truly reflect the outgoing keyed signal. Also, irritating key clicks which are present only in the immediate ham shack are detected by the receiver. Not only does the receiver give out an erratic CW tone but these irritating clicks also.

If the transmitter oscillator stages are allowed to run continually to prevent chirp, the keyed signal can hardly be detected in the average receiver. The transmitter oscillator signal – being the same as that of the final – allows no distinguishable difference in the keyed tone. It is essential then that we directly sample the outgoing power and utilize this as an example of the keyed signal.

Not only is it essential to monitor our fist but also to observe the reflected power ratio. The reflected power ratio gives us an idea of how well the power leaving the transmitter is being accepted by the antenna. There is no such thing as a perfect match to the antenna and some power, no matter how small, will be reflected. The main objective is to achieve the lowest reflected power with maximum forward power. This indicates that power is being radiated by the antenna rather than generating heat within the transmitter or transmission line.

The CW monitor uses very inexpensive and easily obtainable components. The tone generating device is merely a transistor oscillator that requires only a very small amount of current to function. In theory, the oscillator requires only 1½V at 8–10 mA to function.

A small rf sample is extracted from the coaxial line going to the antenna. A 1N34 or similar diode rectifies this rf and the resultant is a dc component. Rf is prevented from coming into the oscillator section by the 470 pF capacitor connected from the plus side of the diodes to ground.

The dc that we have generated is adequate to power the entire transistor oscillator. The rf necessary to generate this dc does not necessarily have to be taken from the transmission line. A small pickup loop may be assembled and placed near the tank circuit of your transmitter. The pickup loop would take the place of the line placed inside the coax.

The audio emanating from the oscillator is at quite a low level so must be amplified to drive a speaker or headphones. An inexpensive imported transistor amplifier

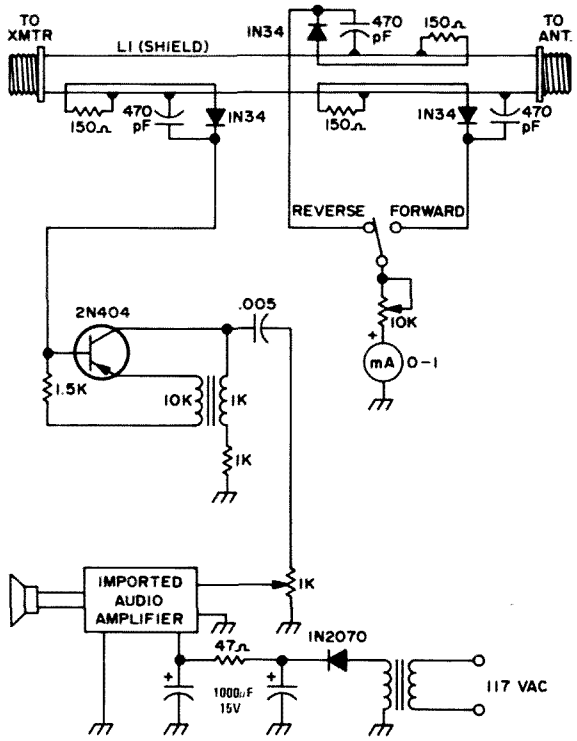


Fig. 1. Schematic diagram. L1 is a 12 in. section of RG-11/U coax with plastic cover removed. Coaxial fittings attached to each end. 5 in. pieces of #20 insulated hookup wire inserted under shield for pickup loops.

with about one watt output power was used in this application. This amplifier boosts the low level audio from the oscillator to speaker level.

The tone oscillator does not put out a pure sine wave but produces one that is rich in harmonics. This actually lessens operator fatigue over extended operating periods.

Rather than operate the transistor audio amplifier with batteries, we decided to construct a simple ac power supply. This eliminates the need for battery replacement at regular intervals. An ordinary 6.3V filament transformer was used with good results.

With the reflected power meter in the FORWARD position, the oscillator may not operate because of consumption of power by the meter circuit. When operating, leave the meter in REVERSE and the oscillator will function properly.

The heart of the reflected power meter is a 12 in. section of RG-11/U coaxial cable. All of the plastic insulation must be removed leaving only the copper braid. The sampling loops are made of 4 in. pieces of insulated hookup wire. There are three of these. One samples energy to power the oscillator and the other two are for the reflected power meter. These 4 in. pieces are inserted under the braid of the coax and the ends are left exposed about ¼ in. It is especially important that the two loops used for the reflected power meter are exactly opposite each other and are symmetrical.

If you will notice in Fig. 1, the 150Ω resistors are soldered directly to the groundshield of the coax. The opposite end goes to the diodes.

In using this device, the coaxial lead from the transmitter is attached to the transmitter end of the reflected power line and the antenna is attached to the opposite, or antenna, connector. The transmitter is then keyed and tuned properly. The calibrate pot is adjusted for full scale deflection of the meter in the forward mode. Once this is completed, switch to the reflected mode and the amount of reflected power will be indicated. If you have a good match between the transmitter and antenna, the reflected reading should be quite low. Maximum forward and minimum reflected is your goal.

When you have completed the previous steps, the monitor section can now be activated. 117V ac is applied to the power supply. This will place the audio amplifier in operation. Each time that the transmitter key is depressed, an audible tone should be heard in the speaker indicating that the oscillator is working and that there is sufficient dc to trigger the oscillator. The volume control should be set for ample volume at this point.

It is interesting to note that the frequency of the oscillator will change as the transmitter is tuned. It therefore becomes an aural tuning device also.

This dual purpose device should provide you with many pleasurable operating hours and also make the proper tuning of your transmitter much easier.

. . .W2AOO

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USING and IMPROVING the TEN-TEC TRANSCEIVER MODULES

A detail discussion of module circuitry, circuit improvements, transceiver packaging and operating experiences.

When the Ten-Tec series of low-power transceiver modules appeared on the market, I purchased them more out of curiosity than with any great expectations that they would be very useful. This thinking goes back to about 1950 when my "large" 100W rig became inoperative, leaving only a 3W vfo–exciter available for QSOs. I had so much fun with the 3W rig on 40 and 20 CW that there followed over the years a continuous desire and search for the circuitry and components to build a truly portable low-power CW transmitter/receiver.

Of course, with tubes, one problem followed the other of trying to keep the battery drain low while still achieving a reasonable power output, trying to extract stable performance from a regenerative receiver on the higher-frequency bands, compromising on crystal-controlled transmitter operation instead of vfo because of oscillator stability problems, etc. The result was never very satisfying, nor economical. Even some of the best "spy" type HF transmitter/receivers built in WWII never resolved all the problems involved, as became apparent later when some of the more widely produced types found their way to the surplus market or into museums.

So, with this background in mind it was very surprising to experiment with the simple and inexpensive Ten-Tec modules in

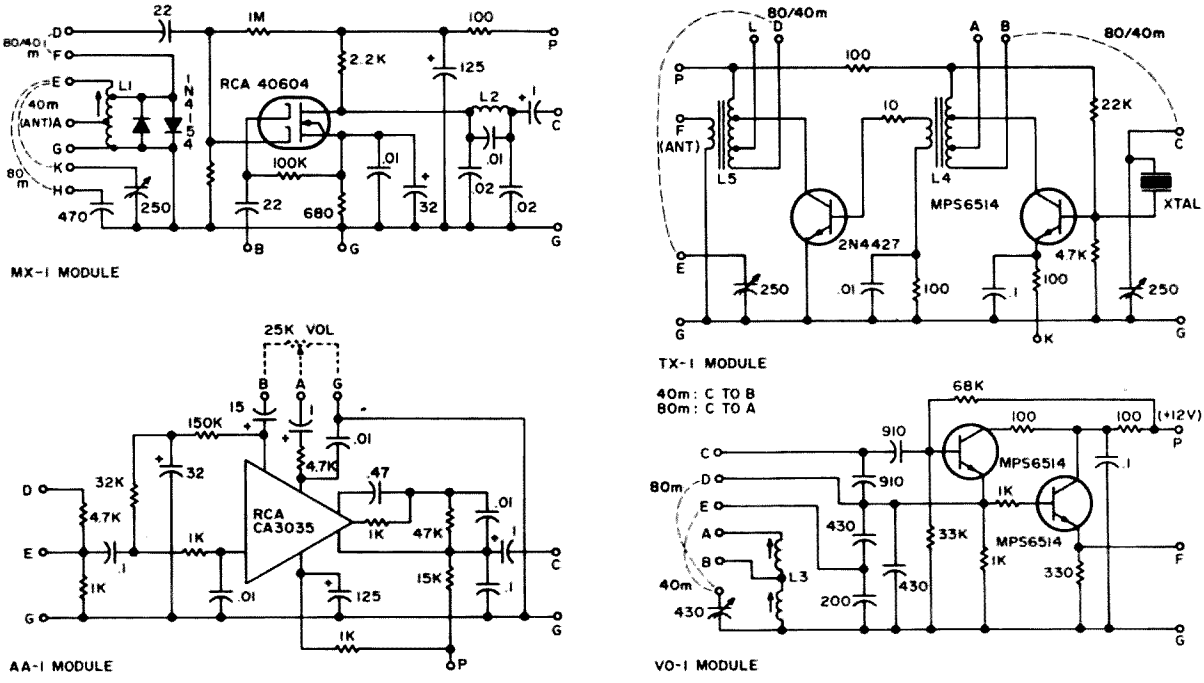


Fig. 1. Diagrams of the original unmodified four modules for the Ten-Tec 80/40 meter transceiver.

an attempt to build a truly compact transistorized and portable CW transceiver and to find that they performed amazingly well. Of course, low-power operation will remain low-power operation regardless of whether tubes or transistors are used. No 2W transmitter is going to sound like a 100W rig regardless of how good it keys, etc. Nonetheless, with a change of operating habits tailored to low-power operation, and that is probably the key to enjoying low-power operation, many satisfying QSOs can be had.

Basic Modules

Figure 1 shows the schematic of the transceiver modules with their actual PC board terminal designations so one can easily understand the interconnection points for the circuit modifications described later. The individual modules are the VO-1 vfo which can be wired for either direct output on 80 or 40 meters and consists of the basic oscillator stage and a direct-coupled buffer output stage.

The TX-1 is a two-stage transmitter which can either be crystal-controlled or driven by the VO-1 at approximately a 2W input level with a 12V battery. The TX-1 can be set for straight-through operation on 80, 40, 20, or 15 meters by means of the coil taps provided. The MX-1 is a dual-gate MOSFET product detector circuit with an approximate 2 kHz audio filter for selectivity in its audio output channel. As with any product detector, it requires an injection voltage (bfo) at its operating frequency which in this case can be provided directly by the VO-1 module on 80 and 40 meters. The taps on the input circuit of the MX-1 allow it to be set for 80, 40, or 20 meters. Operation of the MX-1 below 20 meters is not recommended by the manufacturer because of its greatly lowered sensitivity. Of course, a converter can be used ahead of the MX-1 to bring another band down to 80, 40, or 20 for use with the MX-1. The AA-1 module is simply a very high-gain (100 dB) audio amplifier that provides enough gain to drive any headphone in the 0.1–2 kΩ category to ear-splitting volume.

80 and 40 meter Operation

The interconnection of the modules for operation on 80 or 40 meters is quite simple by following the manufacturer's instructions. The VO-1 feeds the TX-1 and

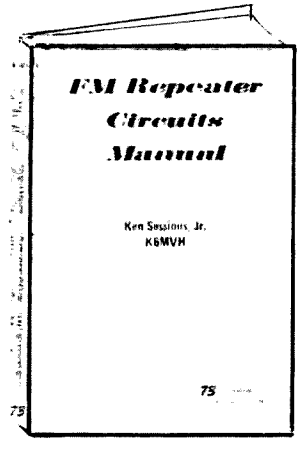
MX-1 modules simultaneously. The original interconnection instructions called for a 50 pF capacitor from the VO-1 output (terminal F) to the TX-1 (base of the MPS6514 via the lower contact on the crystal socket). Latter instructions call instead for only a 3.3 kΩ resistor since the TX-1 when keyed was found to pull the frequency of the VO-1 quite a bit. The manufacturer now recommends this change. The antenna used is switched back and forth between the TX-1 and MX-1. No tone can be heard in the headphones during transmit because the product detector is always tuned to the same frequency as the transmitter. However, to eliminate the annoying thumps heard, terminal E on the AA1 can be grounded during transmit. Switching of the 12V supply to the AA-1 to quiet it, does not work well because the large capacitors used cause a time delay when the unit is switched on before the gain comes up.

One of the most immediately noticeable difficulties in operation is the limited bandspread provided by the VO-1 module. It covers far more than the entire 80 and 40 meter bands in one half-turn of the vfo capacitor. It is unlikely that most users will require this sort of coverage if they are interested in just the CW portions of the band. The solution is quite simple. The 430 pF vfo variable capacitor is replaced by a 150 pF capacitor fully meshed, the slug of the 80 meter vfo coil (bottom slug in coil can) is adjusted to place the vfo output at 3500 kHz and the slug of the 40 meter vfo coil (top slug in the coil can) is used to place the vfo output at 7 MHz. In this manner, just the CW portions of either band is covered and the ease of tuning is greatly improved. If one were to also add a 6:1 gear reduction drive to the tuning, such as that provided by the inexpensive ($1.50) Jackson Bros. reduction drives, a really excellent tuning system would result. A further modification to the VO-1 would be to regulate the supply voltage to the unit. Although regulation is not required when using fresh batteries to power the transceiver, after some hours of operation the internal resistance of two series-connected 6V batteries, or three series-connected

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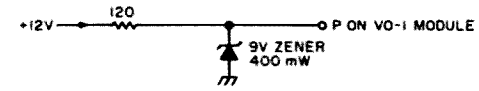


Fig. 2. Simple zener regulator improves transceiver stability greatly when battery supply starts to become "soft" after several hours use.

4.5V batteries, does build up and vfo chirp during keying becomes apparent. The simple solution is a 9V zener regulator for the VO-1 module, as shown in Fig. 2. Reducing the operating voltage of the VO-1 to 9V from its nominal 12V did not produce any noted reduction in output of the TX-1 module, nor in the receiving sensitivity of the MX-1 module.

Another simple addition to the modules when they are used on either 80 or 40 meters is a keying monitor and a transmitter rf output level indicator. The manufacturer does produce a keying monitor in two forms. The AC-2 module is just a keying monitor, but it is a bit elaborate and expensive as compared to the other modules for the purpose of providing just basic sidetone.

The AC6 module is a better value since it contains for about the same price not only a sidetone oscillator, but a VO-1 doubler (discussed later). However, the doubler circuit is not needed for basic 80/40 meter operation. The AC-6 keying monitor is also of the phase-shift type which produces a very good sine wave output, but is a bit superfluous when only

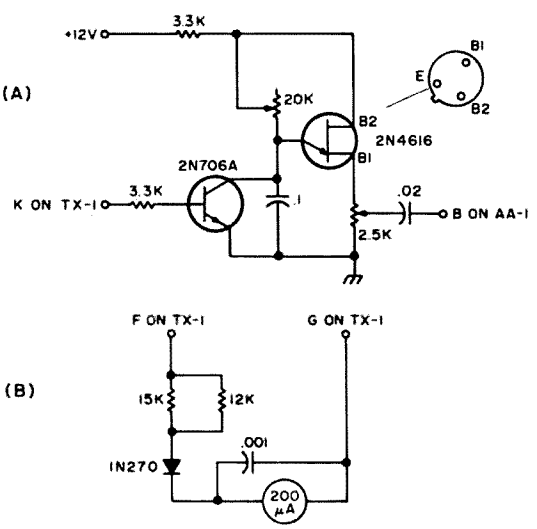


Fig. 3. CW monitor (A) with adjustable tone and volume and rf output level circuit (B).

basic sidetone is required for a portable transceiver. The use of a 300 mA meter in the battery supply lead for tuning purposes, as recommended by the manufacturer, is certainly easy to use and does give a continuous indication of the input level to the TX-1 module. However, when dealing with such a low-power unit, it does appear advantageous to instead have a tuning indicator which shows that the maximum possible power output is being obtained.

Figure 3 shows the CW monitor developed by the author, as well as a simple rf level output monitoring circuit. The CW monitor, if one disregards the 2N706A, is seen to be a very simple unijunction sawtooth oscillator. The output is fed to the AA-1 module, but beyond the point where the volume control for the AA-1 module has effect. Thus, the sidetone volume will remain constant regardless of how the AA-1 volume control is changed during receiving. The 2N706A stage operates as a switch controlled by the TX-1 keying terminal voltage. Under key-open conditions, about 3V is developed across the key terminals. This voltage applied to the base of the 2N706A causes the transistor to "short" the .1 μF capacitor in the 2N4616 emitter lead and that stage cannot oscillate. Under key-down conditions, the 2N4616 stage is free to oscillate. The monitor circuit produces a very cleanly keyed sidetone because of the 2N706A switch. The output frequency is adjustable by varying the 20 kΩ potentiometer in the emitter lead and the output level by varying the 2.5 kΩ potentiometer in the base 1 lead. The rf output level circuit is simply a series rectifier circuit employing a sensitive 200 μA meter connected across the link output of the TX-1. The high series resistance used insures that the circuit will have no effect upon the low impedance output loading of the TX-1. It is used the same as any rf output level circuit, with the tuning capacitors in the TX-1 both simply being adjusted for maximum output level on the meter.

The performance of the transceiver on 80 and 40 meters, once the above modifications have been made, is very satisfac-

tory. Keying is good and the stability during receive is excellent. SSB reception can be done quite easily with the expanded bandspread tuning. The CW reception is really surprising and one wonders how so many signals can be heard with even the simplest of antennas using such a simple receiver. The answer is perhaps not hard to find when one considers the high conversion efficiency and low noise factor of the MOSFET used in the MX-1 module, plus the extremely high gain of the AA-1 module. The mating of the MX-1 and AA-1 modules is very well designed. A 1.0 μV or less signal on CW can be copied quite easily. A comparison of the MX-1 and AA-1 combination to any expensive communications receiver will, of course, demonstrate the superiority of the latter. However, the comparison of the modules to several of the medium price range receivers, or receiver portions of inexpensive transceivers, is rather disturbing. Not only does the module combination seem to perform just as well on CW but the freedom from spurious mixer responses, images, etc. provided by the module combination is really refreshing on the extremely crowded, BC infested lower frequency bands. It is a rather new experience to again be confident that what one is hearing is really on the frequency being received, rather than the creation of poor receiver design. The CW selectivity of the modules is not adjustable since it is determined by the audio filter in the output of the MX-1 module. However, one can adjust the slug in the large inductor (L2) of the MX-1 to vary slightly the audio frequency filter bandpass to a setting more suitable to individual preference. The audio gain of the AA-1 is so great that a sharp audio filter such as the surplus and inexpensive FL-8 can easily be added between the MX-1 and AA-1 when space is available to provide extreme audio selectivity without any additional circuitry.

Operation on 20 and 15 Meters

The first inclination when one investigates the usage of the modules on 20 meters is to be a bit critical of the manufacturer. The TX-1 and MX-1

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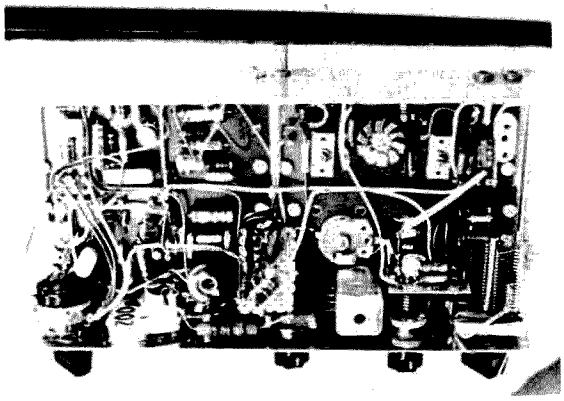
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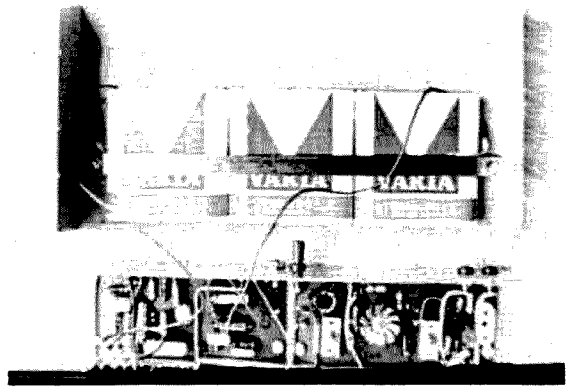
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Top view of the four basic modules as packaged by the author into a single band transceiver. Details of modifications made are discussed in the text.



The power supply for the author's portable transceiver consists of three 4.5V flat batteries held in the top cover of the transceiver enclosure.

modules cover 20 meters with their tuned circuits but the VO-1 module output must be doubled to provide drive to the TX-1 and an injection voltage for the MX-1. It would seem that better design of the VO-1 could have provided this simple feature. However, some consideration of the modest cost of the modules must also be included.

The manufacturer does provide a module (AC-6) which contains a frequency doubler for the 40 meter output of the VO-1, plus a CW monitor. However, a simple frequency doubler can be constructed, as shown in Fig. 4, which will also serve the purpose. The FET doubler shown in Fig. 4(A) provides about 2V at 14 MHz which is more than adequate for the TX-1 and MX-1 modules. However, even when using this FET circuit there was found to be noticeable "pull" on the frequency of the VO-1 unless the drain circuit of the FET was carefully tuned so that the output frequency of the TX-1 remained the same under key-down conditions and under key-up conditions when only the feed-through of the VO-1 and the doubler could be heard in a receiver. A less critical circuit is shown in Fig. 4(B). This two-stage doubler provides a broadband doubler, plus a buffer stage, so pull on the VO-1 is eliminated when the frequency of the latter is doubled from 7 to 14 MHz.

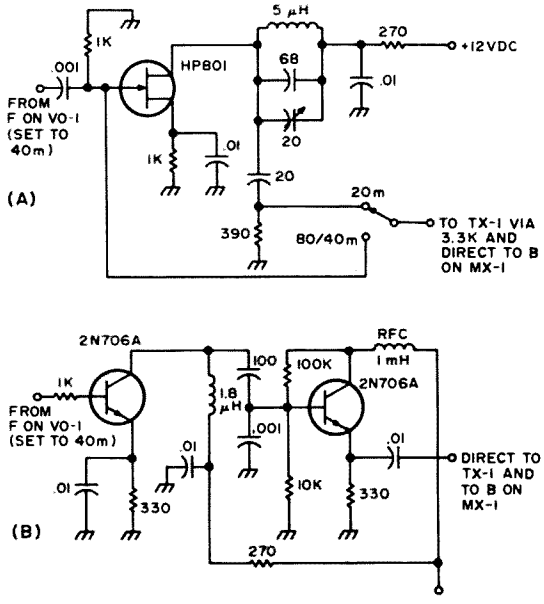
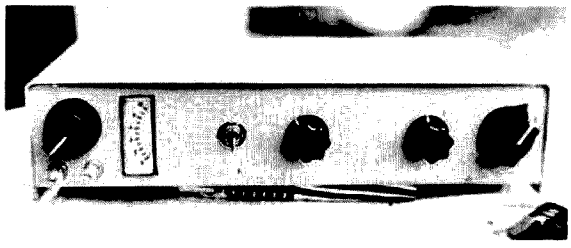


Fig. 4. FET doubler circuit (A) to convert 40 meter VO-1 output to 20 meters. Dual stage circuit (B) provides better vfo isolation and can also be used as tripler for 15 meter operation.

Operation of the modules on 15m becomes a bit more complicated in that if vfo operation is desired, the 7 MHz output of the VO-1 has to be tripled, but the MX-1 cannot operate on 15m and requires a down-converter to translate 15m to 40m. Of course, the necessary circuitry can be provided and one can use the circuit of Fig. 4(B) as a tripler by changing the value of the inductor in the 2N706A collector lead. The manufacturer recommends crystal controlled TX-1 operation on 15m. A rough check indicated that the TX-1 output dropped at least 50% on 15m as compared to its 40m output.

Packaging the Modules

After experimenting with the modules on various bands, I decided to package



Front view of the complete book-size transceiver package. Controls on front (left to right) are volume with headphone sockets underneath, meter, send/receive switch, final tuning, band-spread tuning, and main tuning.

them into a truly self-contained, compact and portable single-band transceiver. I decided on 20 meters as the best compromise band for reasonable performance, portable antenna size, DX possibilities, etc. However, the construction described can certainly be applied to usage of the modules of any other band, or even for multiband usage.

The first photo shows the placement of the four basic modules in the bottom section of an 8 x 4 x 2 in. enclosure (similar to BUD CU-592). The modules are all mounted on the enclosure bottom plate with the standoff hardware provided with the modules. The VO-1 module is at top left, the MX-1 module at top right, the TX-1 module at bottom left and the AA-1 module at bottom right. The placement of the modules in this fashion was deliberately done so the low-profile modules would be to the rear. This allowed the accommodation of the battery supply in the rear upper half of the enclosure, as shown in the photos. In the first photo, you can see the main tuning capacitor (150 pF) at the upper left hand corner. This capacitor was used to replace the 430 pF variable removed from the VO-1 module. Next to it is a 25 pF variable wired in parallel to the 150 pF variable and used as bandspread tuning. The bandspread tuning was added because no reduction drive was used for the main tuning capacitor. It allows far easier tuning to be done over a narrow frequency range, especially under heavy QRM conditions. The VO-1 doubler circuit is mounted on perforated board stock immediately to the rear of the bandspread capacitor and to the left of the VO-1 inductor can. The CW monitor circuit is mounted on board stock and visible in the top center between the VO-1 and MX-1 modules. The tone and volume potentiometers are PC board types and are not brought out as front panel controls. Once adjusted, they can be left as set. Somewhat hidden behind this board is a 500 pF paper variable capacitor of the transistor radio type. It is used for peaking the 2N4427 output and is connected between ground and terminal L on the TX-1 board for 20m. Terminal E on the TX-1 board is then left unconnected. It was found not to be necessary to tune the MPS6514 stage, nor the input circuit of the MX-1 via front panel controls when operating over a 100 to 150 kHz band segment. These stages are peaked with the components already provided on their PC boards. The 200 μA meter is clearly visible and next to it is the 25 kΩ volume control with on/off switch.

The transmit/receive switching circuitry is a bit more elaborate as that previously described and is detailed in Fig. 5. The circuitry allows battery level monitoring and rf output level monitoring, as well as the usual transmit/receive transfer functions.

Operation of the transceiver on 20m has been both rewarding and challenging. There is little more to do with the transceiver in operation except to peak the front panel final tuning capacitor for maximum rf output level on the meter. A 20m dipole cut to frequency provides excellent loading.

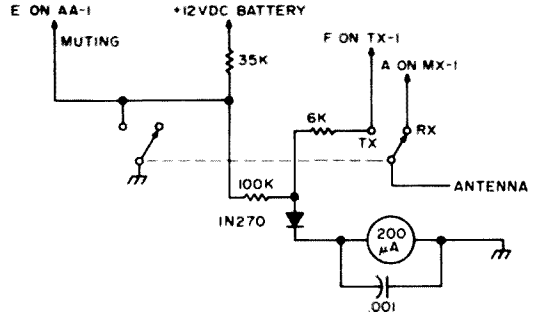


Fig. 5. A more elaborate send—receive switching circuit which provides antenna switchover, receiver muting during transmit, meter indication of battery level during receive, and meter indication of rf output level during transmit.

The operating rules for a transceiver of this power class can probably be expressed in two phrases:

1. *Never* call CQ as it is a complete waste of time.

2. When answering a CQ, wait first to hear if any strong sounding station replies also. If so, do not attempt to call the station, unless he later sends a QRZ and cannot apparently establish contact with the first station who called. The rules are simple to state and difficult to follow. But, QSOs will result instead of discarding low-power operation as a waste of time.

Further Improving Performance

The modules themselves work so nicely for their intended purpose that there inevitably follows the desire to use them as the basis for more elaborate equipment. Particularly in the case of the MX-1, there is considerable value to this idea as with some additional circuitry the MX-1 can be transformed into an excellent and inexpensive CW receiver that could rival any of the cheap-to-moderate priced receivers on the market.

Figure 6 shows an FET preamplifier stage that provides a good boost to the MX-1 sensitivity by complementing its existing low-noise FET characteristics. It is not recommended that other types of transistorized preamplifiers be used before the MX-1 since very few will have the noise characteristics necessary. Broadband, untuned amplifiers are particularly unsuitable. The circuit shown provides two additional tuned circuits before the MX-1 for added front-end selectivity. In fact, one could carry this sequence further by adding more preamplifier stages with high-Q tuned circuits in the style of the old trf receivers with 2 to 4 rf amplifier stages. One additional preamplifier stage increases the sensitivity to about 0.1 μV on CW. The circuit of Fig. 6 can function also as a mixer on 15m to down-convert 15m into the MX-1. Used in this manner, it will perform very well as a complement to the TX-1 on 15m. If one wanted to increase the 15m sensitivity further, however, an additional 3N140 amplifier stage should be used ahead of the circuit shown with 15m coils used in both the gate and drain tuned circuits. As was mentioned before, the AA-1 module provides so much gain that an additional audio filter can be used between the MX-1 and AA-1 units. A surplus FL-8 type is very suitable and L2 on MX-1 should be shorted out for this purpose. Another approach is to use a transistorized notch filter between the MX-1 and AA-1 without disturbing the audio filter on the MX-1 board.

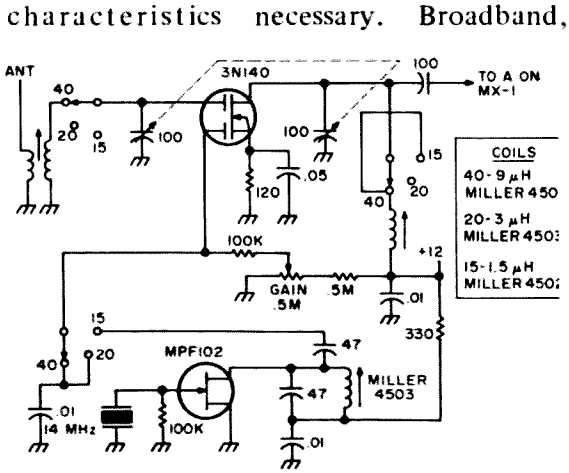


Fig. 6. Improved receiver performance can be achieved by a simple MOSFET preamp. Circuit shown can be built as a single band preamp if desired. As shown, it functions as preamp on 40 and 20m and as a down-converter to 40m for 15m input signals.

Even if one totals up the cost of the components necessary to provide preamplification, improved audio selectivity and vernier oscillator tuning for the MX-1/VO-1 combination on 80, 40, or 20 meters, it will be far less than the expense of any commercial superheterodyne receiver. However, "clean" reception due to the lack of spurious responses and the superior overload characteristics of the FET MX-1 and FET preamplifier will make reception much more enjoyable.

The TX-1 performance can be improved by the addition of another transistor PA stage. However, there is probably not too much value to increasing the power level for portable operation to the 5–20W category. Successful operation at these levels is almost 90% a question of operator techniques. The minimum power level which probably should be aimed for if one wants to boost the TX-1 level to a really useful value is 50–70W.

. . . W2EEY ■

Albert H. Coya WB4SNC
1710 SW 83rd Ct.
Miami FL 33155

HAM HOSPITALITY a la LATIN

The muffled sound of the telephone bell awakened me. My hand reached out in the dark trying to locate the phone. I had just fallen asleep a few minutes earlier.

"Hello?"

"Albert, I'm sorry to wake you up at this time, but you are flying tomorrow morning to Nicaragua."

"What? What is going on in Nicaragua?"

"A volcano is erupting, and we need aerial pictures of the volcano and a first-hand story on the refugees and damages."

When you are a press photographer and you work for the largest newspaper in the South of the United States, this conversation is not unusual. I am the only Spanish-speaking photographer on the staff of *The Miami Herald* so every time something is cooking in Latin America it is a good bet they will send me down there. The mud of the Puerto Rican floods was still fresh on my shoes.

"We have reservations for you at Lanica Airlines, 8:00 AM," instructed my boss' voice.

"Okay, I'll be at the airport on time."

I looked at the clock. It was midnight. I had not been in Nicaragua before, and I needed some fast information on what was going on there. My thoughts went to my ham rig lying there in the shack. Anyhow, I could not go back to sleep, and the XYL was already looking for my light suitcase.

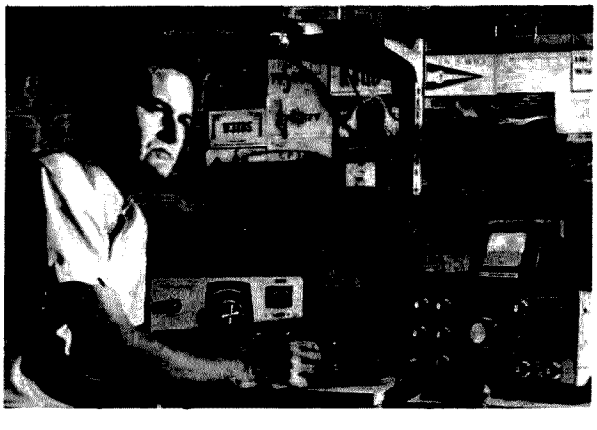
While the coffee pot was getting hot, I went down to the shack and turned on the rig.

The familiar rushing noise came from the speaker. I tried 20 meters and to my surprise I found it was still open and a few QSOs were going on. I stopped the dial in the spot where a conversation in Spanish was in progress. After listening a few minutes, I hadn't heard any identification, so I decided to break in.

"Break, break, this is WB4SNC in Miami, looking for Nicaragua – is Nicaragua on the frequency, please?" I said in Spanish.

"A station from Miami is breaking in, Carlos . . . " said one of the voices in Spanish.

"I am looking for Nicaragua, amigo. I need some information on the volcano eruption."



W B4SNC, Albert Coya, at his shack. The equipment is a HW-101 Heathkit, a HW 32 monobander for 20 meters, and a homebrew linear. Other gear shown: homebrew phone patch, frequency counter, keyer, SWR meter, monitor scope, and power supply for both rigs.



Jaime Saenz, YN2JS, at his shack in Granada.



"Hey, Jaime, that call is for you!" another voice said.

I couldn't believe it. My first try, and there it was: a Nicaraguan station!

"Hello, this is YN2JS, in Granada, Nicaragua. The name here is Jaime Saenz. Can I help you in any way, amigo?"

"Wow! Boy, I am lucky! Jaime, this is WB4SNC, in Miami – the name is Alberto. I am a newspaperman and I have to fly to Nicaragua tomorrow morning to cover the eruption of the volcano Cerro Negro, and I need some information on what is going on. Is your city affected by the eruption?"

"Oh, no, we don't have any problems here. The volcano is in the west side of the country and the most affected city is Leon. The damages are estimated in many thousands of dollars, and the refugees are pouring out of the vicinity of Cerro Negro. At what time are you coming?"

"I am taking the 8:00 AM plane, and I will be there before noon."

"Okay, I will wait for you at the airport."

"What?"

"Do you copy me?" Jaime said, "There is no QRM in this side; I repeat – I will wait for you at the airport."

I thought I was having trouble again with my lousy dipole. I blamed myself again for not putting that quad up the previous weekend.

"Hola, this is WB4SNC in Miami, do you still copy me, Jaime?"

"Si, go ahead."

"You said you will wait for me at the airport, I believe. But, Jaime, you don't have to do that. I only need some information on the volcano, so I will know where to go from the airport. You don't have to wait for me. Of course, it will be very nice of you, and I will have the pleasure to shake your hand, but I don't want to bother you . . . YN2JS, this is WB4SNC in Miami, go."

"It is no bother at all, old man. I will wait for you at the airport, and that is final."

"Okay, Jaime, if you want it that way. Please, rent me a jeep or a four-wheel traction truck for rough terrain. Money is no problem. Probably I will have to rent a



Cleaning the streets.

plane, but there's a good chance the government will let me use military transport. I must take some aerial pictures of the volcano before we go by land in the jeep."

We said "hasta manana" with the usual courtesies, and I went to bed to grab a couple of hours of sleep.

I reached the Lanica counter at 7:00 AM.

"Sorry, senor, the plane departed five minutes ago."

"What? They told me the flight was scheduled for 8:00 AM."

"Last night's clerk made a mistake, and we are very sorry about it."

I grabbed a phone and called the editor.

"Postpone everything, Albert, maybe you'll be able to take another plane in the afternoon," he said.

I went back home. I wanted to call Jaime and tell him not to wait for me.

Again to the shack, looking at 9:00 AM for a Nicaraguan station. I have only thirty minutes to contact Jaime. After trying for ten minutes, a YL voice in Spanish answered my call.

"This is HC2NA, In Guayaquil, Ecuador, old man. I have a sked with Nicaragua in one hour, and maybe I can relay the message. The handle here is Nena."

I told Nena the story and asked her to tell Jaime to wait for me at noon on 15 meters around 21.280 kHz.

Back in the office, the editor's secretary gave me a ticket for a Pan American flight that afternoon. Things looked better then, and I went home to contact Jaime and get my suitcase.

The sked was on time and YN2JS answered my call.

"New arrival time, Jaime – I think I will be in Managua around 6:00 PM. 73, and I will see you later. Hasta luego."

"Muy bien, Alberto, I will be waiting for you."

But something was against my plans. The Pan Am flight was not direct to Nicaragua, and the first stop – San Pedro Sula, Honduras – was diverted because of bad weather, and the plane landed in Guatemala.

The last news said that the volcano was losing power, and I knew the only chance I had to take pictures of the action was flying there the next morning; not later.

Somebody up there must like me, because my prayers were answered and Pan Am sent a plane to pick up the passengers to Nicaragua.

The 707 landed in Managua at 9:45 PM, and I was worried about Jaime waiting all that time. I thought I wasn't going to find him there, but I was wrong, and a young, smiling, tall fellow extended his hand to me.

"You must be Alberto, WB4SNC . . . "

"And you are Jaime, YN2JS . . . "

We shook hands. The jeep with the driver was waiting for me. This was my first test of what the international brotherhood of ham radio is.

We had a typical Nicaraguan meal, with "churrasco" (thick steaks broiled on charcoal) and country beer.

The next morning Jaime had the jeep and the driver waiting for me at the hotel, and from there we went to the military airport. After some red tape, we used a government plane and finally flew over and took pictures of the volcano. It was a very impressive spectacle!

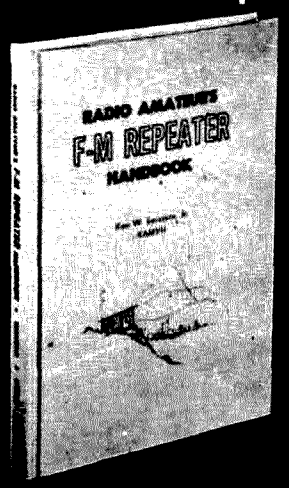
After returning to the airport we drove the hundred miles to Leon, and started looking for refugees and signs of destruction.

The city of Leon was covered by a thick blanket of black volcanic dust. Red Cross, civic institutions, and radio operators had joined in a well-coordinated net to help the refugees.

Every time the winds blew, the microscopic dust got airborne and made us cough and sneeze. After six hours in the place I felt as though I had sinus trouble.

Talking to the refugees, I realized all the tragedy of these poor people driven from

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Little refugee with the dust of the volcano on her face.

their small farms with only a few belongings over their shoulders.

We went back to Managua after visiting places accessible only by jeep. Jaime insisted that I check out of the hotel and go to his home and meet his family and friends in Granada. He lives in a palatial home with his parents and eight brothers and sisters. The house was very appropriate for a big family – a two-story green building, with a quad antenna one hundred feet in the air. A typical Spanish home with a central patio, and the flavor of the old country, complete with real hospitality, Latin ham style.

After dinner that night, Jaime took me to the Jockey Club to meet his friends, a group of radio amateurs alerted by him of my presence in Granada. Of course, we talked radio, and they made me feel at home, forgetting how tired and sleepy I was.

We called Miami and made a contact on 75 meters with WA4ZZG, Rafael Estevez, who ran a phone patch with my XYL at one o'clock in the morning.

This is the story of my fast trip to Nicaragua and my first contact with what really exemplifies the brotherhood of ham radio: an unwritten code of gallantry and courtesy.

. . .WB4SNC

GENERAL CLASS LICENSE STUDY GUIDE

Questions & Answers Part I

For a little over three years, we have been presenting a more-or-less continuous series of study courses for the General, Advanced, and Extra class licenses, which avoided the "question-and-answer" format so popular with many license courses in favor of explanation in depth of the theory behind the questions.

Content of these courses has been determined by the "study questions" made available by the FCC for would-be applicants. We refrained from using the Q&A format in the belief that it would lead toward memorization of the material rather than toward learning of the processes involved – and in a conviction that actual understanding of the theory was of far more importance to future enjoyment.

However, we recognize that some readers can comprehend the material more rapidly by a Q&A technicue than by our extended technical discussions, and also that anyone can make use of a checklist against which to test his understanding.

We must emphasize that for some questions a number of answers may be correct, and our answers do not attempt to provide all the possible correct responses. In some cases, the study questions are so phrased that no "correct" answer is possible (for instance, question 1 below). In these cases, we simply indicate the source or sources from which material satisfying the question may be obtained.

Many of our answers contain references in parentheses. These references are to installments of our previous study courses, and indicate where detailed discussion of the principles involved may be found.

The study list for each class of license is far longer and more detailed than is the actual examination. In addition, most of the questions in the actual exam are of the multiple-choice type, in which you select the right answer from several (usually five) possibilities, while those in the study list call either for direct specific answers, or for discussion. Both these differences are apparently designed to help assure that anyone who can answer all the questions on the study list accurately will have little difficulty with the actual examination.

1. Questions based on Part 97 of the Commission's rules.

This is not a specific question and so cannot be answered directly. It is intended to indicate that the actual exam will contain a number of questions dealing with permissible subbands, operating procedures, and so forth, all of which are spelled out in Part 97 of the FCC Rules and Regulations. A copy of Part 97 may be otained from the Government Printing Office, or found in some of the larger public libraries. Be sure to check the latest edition; the rules change with sufficient rapidity to make this caution necessary.

2. Of what use is a bleeder resistor in amateur equipment?

A bleeder resistor is an integral part of a power supply, and serves two primary purposes. From a technical point of view, its primary purpose is to provide a definite minimum load upon the power supply and thus improve regulation and filtering. From the viewpoint of operator safety, its primary purpose is to "bleed" off the energy stored in the filter capacitors and so prevent electrical shock. However, resistors can open-circuit without warning, so that a bleeder resistor should never be trusted when you work on a power supply; this makes the safety purpose somewhat deceptive.

3. Define skin effect. How can this phenomenon be minimized?

"Skin effect" is the tendency of radio-frequency energy to travel on the surface of a conductor rather than uniformly throughout the conductor's volume. This causes the rf resistance of a conductor to be greater than its dc resistance. The effect can be minimized by using conductors with large surface area (strips or tubes rather than solid wire), and by using "litz" wire which consists of many small strands of wire so braided that each is on the outer surface for the same percentage. (General course, Part IIB)

4. List some operating procedures which can be employed to minimize interference and congestion of the amateur bands.

Avoid excessively long transmissions, always listen before transmitting (to be certain that the frequency is not already occupied), speak clearly and distinctly to reduce the need for repeating information, and do your operating when the bands are least heavily occupied. (General course, part XII)

5. Describe the operation and usage of a cathode follower.

The cathode follower is a vacuum-tube amplifier circuit in which the plate is grounded (so far as signals are concerned) and output is taken from the cathode. As the grid voltage is varied by the input signal, current through the tube also varies. The current variation appears as voltage variation across the cathode resistor. This variation in cathode voltage opposes the change in grid voltage, producing very high input impedance for the circuit and a voltage gain always smaller than 1. High current is available, however, and the high current and low voltage of the output result in low output impedance. The cathode follower is frequently used as an impedance transformer or "isolation" circuit because its high input impedance imposes little load on the driving circuit, and its low output impedance makes it relatively insensitive to loading by the circuit which it drives. (General course, part V)

6. How does frequency tolerance affect band edge operation?

The existence of a "tolerance" implies possible errors, and in order to be certain that one is operating whtin the limits of a band it is necessary to add the maximum possible error permitted by frequency tolerance to the supposed frequency, when at the upper band limit, or subtract the maximum possible error, at the lower band limit. If this is not done, the error may put your actual signal outside the band limit, which is illegal. (General course, part VIII)

7. What is impedance matching and why is it important?

Impedance matching is the name given to the process of assuring that each of two separate components in a signal chain is operating under the conditions for which it was designed. These conditions are normally specified in terms of "impedance"; and when impedances are matched, power transfer is most efficient. In ham parlance, "impedance matching" is usually applied to discussions of matching antennas with feedlines and feedlines with transmitters. In this case, an approximate match is necessary to achieve satisfactory power transfer or "loading" and to minimize undesired radiation by the feedline. (General course, parts IV and XI)

8. How is the plate circuit efficiency of a vacuum tube determined?

Divide the measured signal power output of the tube by the measured dc power input. The result will always be a fraction smaller than 1. It is normally expressed as a percentage. (General course, part V)

9. What is amplitude modulation (AM)? How is the intelligence conveyed in an AM signal?

Amplitude modulation is a technique for conveying information by varying the amplitude or strength of the transmitted signal. It is the most commonly employed form of telephone communication. In AM, the intelligence is conveyed in a pair of symmetrical sidebands, one on each side of the carrier wave. The sideband energy mixes with the constant energy of the carrier wave to vary the amplitude of the composite signal envelope. (General course, part IX)

10. What is meant by the ripple frequency of an ac power supply voltage?

"Ripple" in the output of an ac-operated power supply refers to the alternating component which remains in the dc output after filtering. "Ripple frequency" is the rate at which the ripple alternates. Ripple frequency is related to the frequency of the ac input power. With half-wave rectification, ripple frequency and input frequency are the same. With full-wave, ripple is at twice the input frequency. (General course, part VII)

11. What is a third party agreement?

International regulations, to which this nation is a party, absolutely forbid international transmission of messages between amateur radio stations on behalf of any person except the two operators involved. Such messages are known as "third party" traffic. The regulations permit the rule to be suspended by special agreement between the two nations involved, however, and such a special agreement is known as a third party agreement. The U.S. has third party agreements with a number of other nations (but not all), and third party traffic may be handled with those nations. (General course, part XII)

12. How does a zener diode operate and of what use is it in amateur equipment?

A zener diode operates by means of the "zener effect" in specially constructed semiconductor junctions, which maintains a constant voltage drop across the junction regardless of the current through it (so long as the device is not burned out by excessive current). The zener diode is used as a voltage regulator, and as a source of reference voltage for electronic regulator circuits. (General course, part VII)

13. Define standing wave ratio (SWR). How can the SWR of a line be determined? How are the SWR of a line and its characteristic impedance related? Name some factors that affect the characteristic impedance of an air-insulated parallel-conductor transmission line.

Voltage standing wave ratio, to give it its correct name, is defined as the ratio of maximum voltage to minimum voltage along a feedline or other conductor which is supporting a standing wave of rf energy.

The swr of a line can be determined by measuring rf voltage along the line, determining maximum and minimum readings, and dividing the smaller into the larger. Alternatively, it may be determined by doing the same with current rather than voltage measurements. Commercial "swr meters" usually measure forward and reflected components of power, and convert the resulting "reflection coefficient" into "swr" by means of their calibration.

The swr of a line is not directly related to its characteristic impedance, but is directly related to the ratio between the impedance of the line and of the load. Swr is equal to the ratio of these impedances. Additionally, swr modifies effective line impedance between limits determined by multiplying line impedance by swr to obtain the upper limit, and dividing by swr for the lower limit.

Factors affecting the characteristic impedance of an air-insulated parallel-conductor transmission line are the spacing between conductors and the conductor diameters. A less important factor is the dielectric constant of the air, nominally 1 but varying with humidity and temperature from day to day. (General course, part XI)

14. What is meant by the maximum plate dissipation of a vacuum tube?

The maximum plate dissipation of a vacuum tube is a rating, normally given in watts, of the amount of heat which the tube's structure can withstand. It is the difference between the dc input power and the output signal power when the tube is dissipating all the power which it is capable

of converting into heat. (General course, part V)

15. What is a decibel?

A decibel is one-tenth of a bel. The bel is the unit of power *ratio*. A power ratio of one bel means that one power level under consideration is ten times the other, regardless of the actual level. The bel is the logarithm of the actual power ratio, so that 2 bels represent a 100-to-1 ratio, 3 bels a 1000-to-1 ratio, and so forth. (General course, part III)

16. What is a harmonic? List ways of minimizing harmonic generation in frequency doublers, vacuum tube amplifiers, transmission lines, and antennas.

A harmonic is an rf signal at two, three, four, or some other whole multiple, times the frequency of the original or "fundamental frequency" signal. Harmonics are generated only in non-linear circuits, and may be minimized by avoiding non-linearity where possible.

The purpose of a frequency doubler is to generate the second harmonic of its input signal. However, odd harmonics may be minimized by use of a push-push circuit.

Harmonics cannot be generated by transmission lines or antennas unless corroded joints are present to introduce non-linearities. Keeping the antenna system in good physical condition, therefore, will prevent harmonic generation there. (General course, part III)

17. What is a crystal resonator?

A crystal resonator, more frequently called simply a crystal, is a thin slice from a quartz crystal used to determine the frequency of an rf oscillator by means of mechanical resonance. Frequency is determined by the shape and size of the crystal. (General course, part VIII)

18. How do electrolytic capacitors operate and why are they widely used in power supply circuitry?

The electrolytic capacitor is composed of two plates of metallic foil, with a moist electrolyte separating them. Chemical action of the electrolyte forms an insulating compound on the surfaces of the plates. This is the dielectric of the capacitor. Because such an electrochemical dielectric can be much thinner than any conventional dielectric, electrolytic capacitors provide large values of capacitance in relatively small packages, and for this reason are widely used in power supply filter circuits. (General course, part VII)

19. What symbols does the Commission use to designate how the main carrier of a signal is modulated?

The FCC uses the alphabetic symbols "A" for amplitude modulation, "F" for frequency or phase modulation, and "P" for pulse modulation, together with numeric suffixes: "0" indicates absence of any modulation, "1" indicates telegraphy without accompanying audio modulation, "2" indicates telegraphy by the keying of a modulating audio frequency or by keying a modulated signal, "3" indicates telephone (voice) signals, "3a" indicates SSB, "3b" indicates two independent sidebands (NOT DSB), "4" indicates facsimile signals, "5" indicates video signals, and "9" indicates signals not classifiable under the remaining codes. Thus "A1" is on-off keying of an unmodulated carrier, "A3" is AM voice, "F1" is frequency-shift keying of an unmodulated carrier, and "F3" is FM voice. "A0", "F0", and "P0" all indicate unmodulated signals, but "A0" is usually used in preference to the other two.

20. What are some possible causes of excessive plate current in a class C power amplifier?

Some of the possible causes of excessive plate current in a class C amplifier are (1) mistuning of output circuit, (2) excessive coupling between output circuit and load, (3) loss of drive (if self-biased) or loss of grid bias voltage (if externally biased), (4) excessive operating voltages on plate, screen, or both, and (5) gassy tube in amplifier. (General course, part VI)

21. List several characteristics of a vertical quarter-wavelength antenna.

If operated against actual ground or an effective ground plane, the vertical quarter-wave antenna has a feed-point impedance of approximately 37Ω and a low vertical angle of radiation. The low angle of radiation makes this antenna effective for skip signals at maximum range, and in the VHF bands, prevents loss of energy at unusably high angles. The horizontal directional pat-

tern is omnidirectional. Radiation from this antenna is vertically polarized. Finally, the quarter-wave antenna is the shortest conductor which can be used as a resonant antenna; any shorter structures must be loaded to an electrical quarter-wave in order to achieve resonance. (General course, part XI)

22. What is TVI? How can it be remedied if the amateur station is at fault? If the TV receiver is at fault?

"TVI" stands for "television interference," or interference to television reception caused by radio signals. Any radio signals may cause TVI; hams are not the only offenders. If the amateur station is at fault, TVI may be reduced by assuring that no rf energy escapes from the amateur station except within ham bands. This is accomplished by shielding and filtering equipment, and by proper adjustment of the transmitter and antenna. When the amateur station is emitting no energy except in assigned amateur bands, any remaining TVI must be due to faults in the TV receiver. Not all these can be overcome, but in general, installation of a high-pass filter in the TV antenna feedline to reject amateur signals, together with (if necessary) tuned traps to specifically reject signals from the interfering station, may reduce the problem. (General course, part XII)

23. How can transistors be used in electronic equipment? What is the beta of a transistor? Compare the elements of a transistor to a vacuum tube's.

With notable exceptions due to power limitations, transistors may be used in electronic equipment in almost any place that a triode vacuum tube can be used. The major exception is that transistors are not yet capable of handling both high frequency and high power simultaneously, although they can outperform tubes both at high power with low frequencies, and at high frequencies with low power.

The beta of a transistor is its dc current gain, measured as the change in collector current for a specific change in base current with both base-emitter and collector-emitter voltages held constant, in the common-emitter configuration.

The emitter of a transistor corresponds to the cathode of a vacuum tube, the base to the grid, and the collector to the plate. (General course, part IV)

24. What is meant by percentage of modulation? What is the maximum legal limit to which an amateur transmitter can be modulated?

The modulation percentage of any transmitter, AM or FM, is defined as 200 times its modulation index. The modulation index is defined differently for AM and for FM. With AM, modulation index is defined as the peak amplitude of the modulating signal, divided by the amplitude of the unmodulated carrier, and is usually calculated by dividing the difference between "crest" and "trough" levels of the output signal by the sum of "crest" plus "trough" to produce a fraction between 0 and 1. For FM, modulation index is equal to maximum deviation divided by maximum modulation frequency. In all cases, amateur signals are limited to a maximum of 100% modulation. (General course, part IX)

25. Describe briefly how oscillators operate. What are the most common types of oscillators and how do they differ from each other?

Oscillators generally consist of an amplifier, a resonator, and a feedback circuit so arranged that output of the amplifier is returned to its input in the proper phase to provide adequate input level and maintain maximum output. Any of these components can be varied to produce a different type of oscillator. Some common oscillator types are the Hartley, which has its feedback network connected in the cathode circuit through a tapped coil; the Colpitts, which employs a capacitive voltage divider for its feedback network; and the Armstrong, whose feedback network is in the plate circuit. (General course, part VIII)

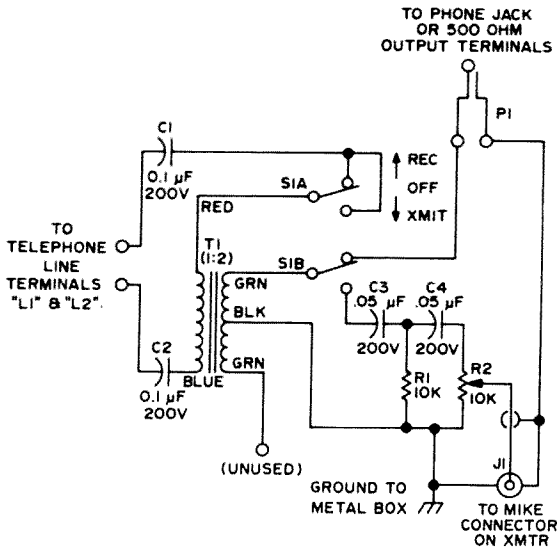
26. Why is a centertap return connection employed on the secondary of a transmitting tube's filament transformer?

To prevent or at least reduce amplitude modulation of the output signal by the ac voltage applied to the filament. (General course, part VII) . . .Staff

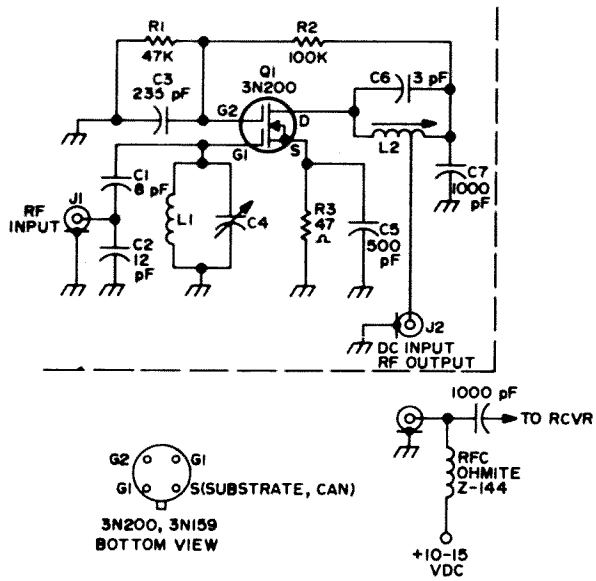
CIRCUITS, CIRCUITS, CIRCUITS...

The following circuits have appeared in the referenced books, magazines, application notes, etc. While we try to reproduce all of the information that should be needed by an experienced constructor, readers may want to avail themselves of the original sources for peace of mind.

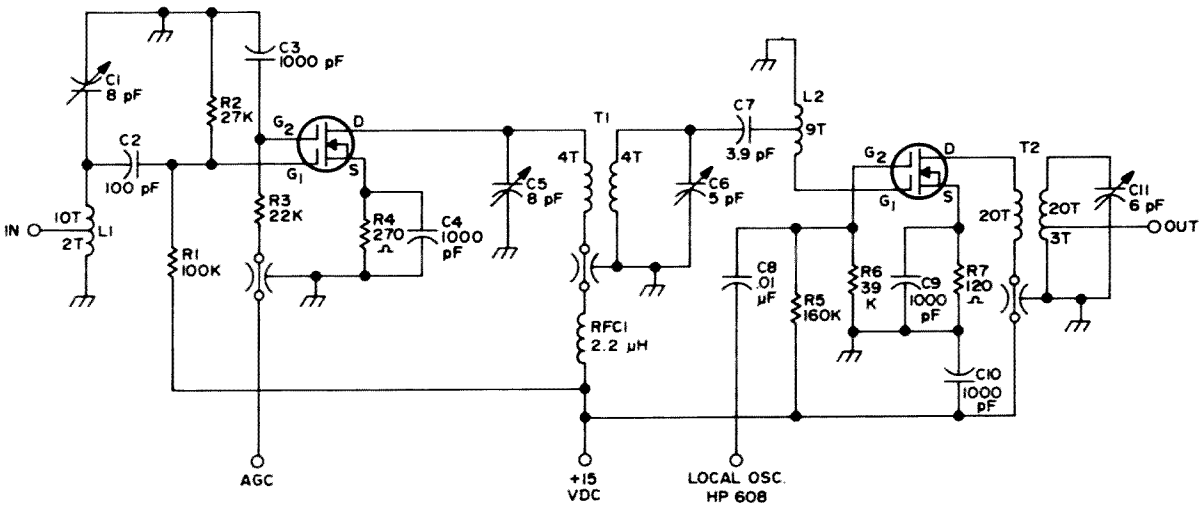
Readers are requested to pass along any interesting circuits that they discover in sources other than U.S. ham magazines. Circuits should be oriented toward amateur radio and experimentation rather than industrial or computer technology. Submit circuit with all parts values on it, a very brief explanation of the circuit and any additional parts information required, give the source and a note of permission to reprint from the copyright holder, if any, and the reward for a published circuit will be a choice of a 73 book. Send your circuits to 73 Circuits Page, 73 Magazine, Peterborough NH 03458.



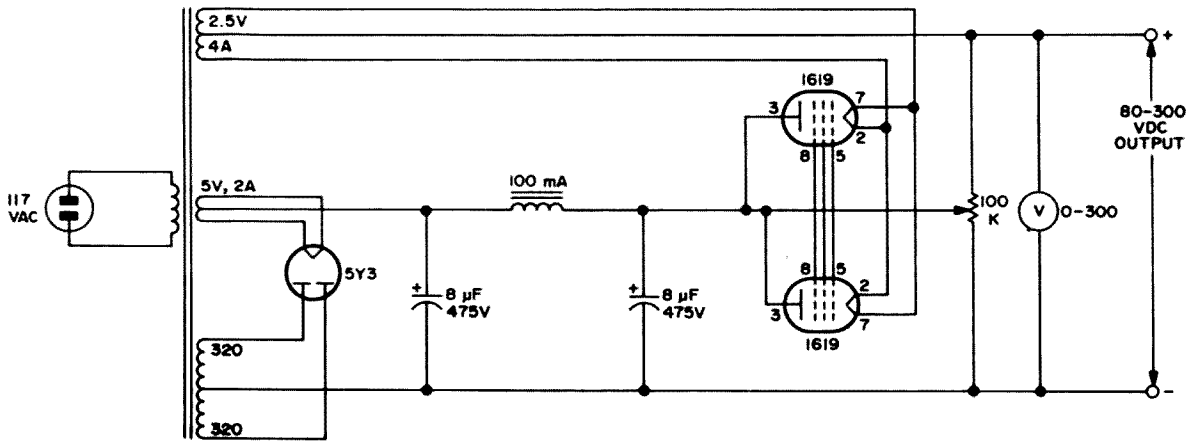
A simple and efficient phone patch, by Herbert S. Brier W9EGQ, from an article by that title in the December 1960 issue of 73. Still as simple and efficient as ever!



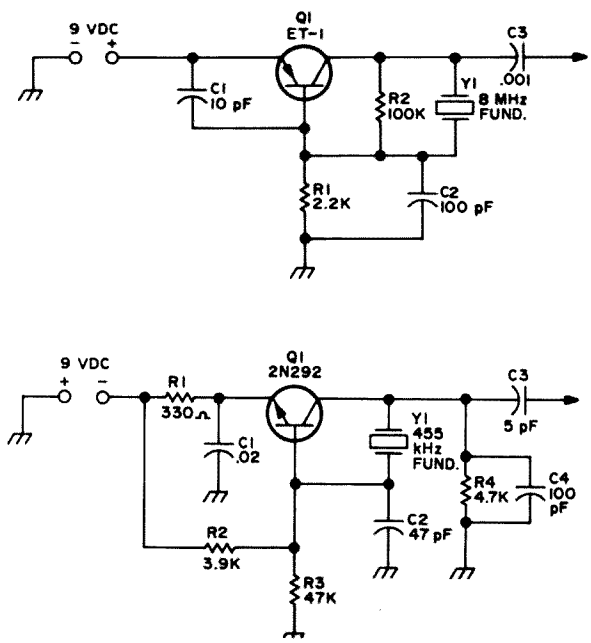
Two meter preamplifier, MOSFET. C4-5 are button micas and support transistor leads forming resonant circuit. L1 is JFD LC374 tank circuit which contains C1. L2 is 6T #22 enamel on 5 mm slug-tuned form, tap at 1 turn. 3N159 will also work in circuit. Circuit courtesy of RTTY Journal, P.O. Box 837, Royal Oak MI 48068. Circuit by W8BBB.



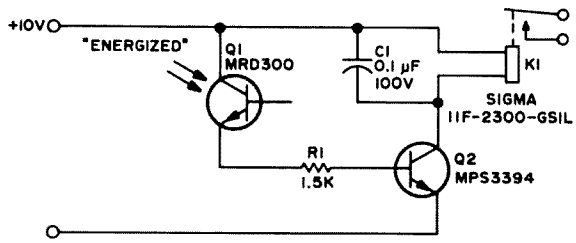
VHF TV tuner using the FT0601 dual-gate MOSFET in RF amplifier and mixer stages, circuit courtesy of Fairchild Semiconductor, 313 Fairchild Drive, Mountain View CA.



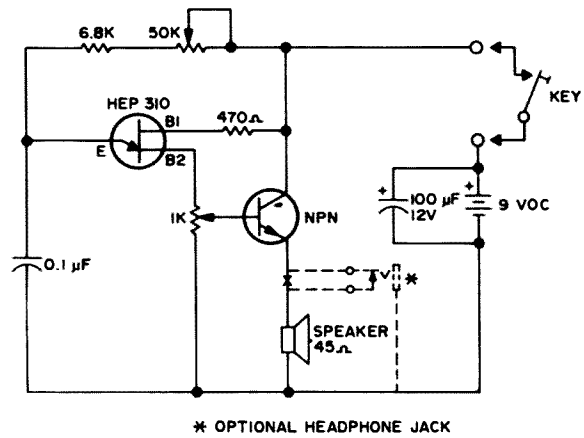
Variable power supply. Here's an oldie but goodie submitted by W4IOI and taken from a 20-year-old Heath flyer. If you keep in mind the filament requirements you can use 6L6s, 6Y6s, 1619s, 807s, 1625s, 837s, etc.



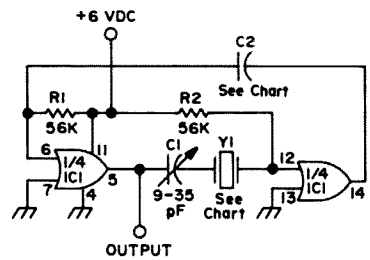
Two oscillator circuits for aligning receivers, anonymously presented, originally, in FM Bulletin, Vol.I, No. 5, June 1967, reprinted in 73's "FM Anthology I," available from 73 Magazine for $3.00.



Light operated relay. It takes 220 foot candles to turn this on. Turning off the light turns off the relay. Circuit courtesy Motorola Semiconductor Power Circuits Handbook.



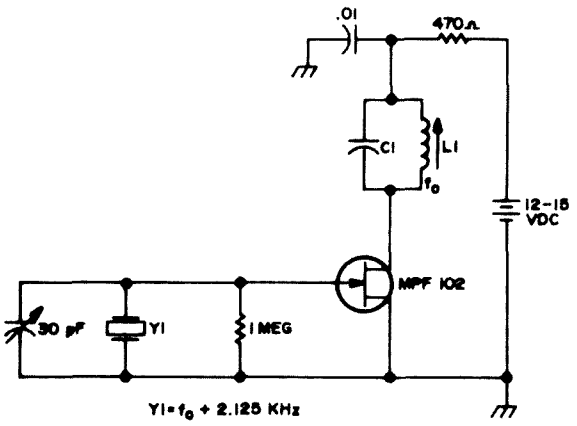
Code practice oscillator or perhaps a noisy alarm for the home, boat or car. Circuit courtesy Calectro Handbook ($.50, GC Electronics, 400 S. Wyman, Rockford IL 61101). NPN transistor is a Calectro #K4-506.



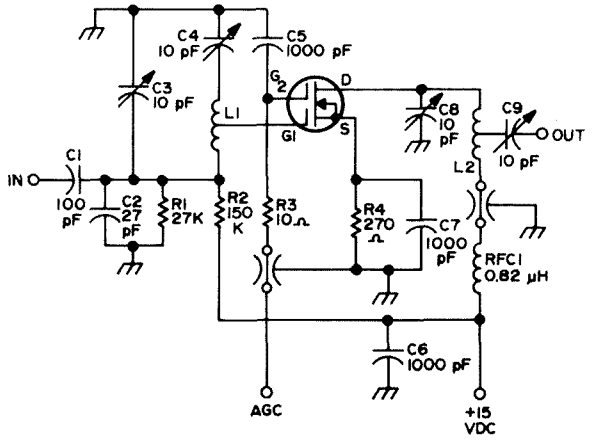
CRYSTAL FREQ	C2 pF
100 KHz	1000
500 KHz	430
1 MHz	39

IC1 - HEP 570

Crystal oscillator calibrator, high in square wave output (which means you will be able to hear it up into the VHF bands), which may be made into two calibrators since the circuit uses only half of the IC. This circuit appeared originally in HMA-36, Radio Amateur's IC Projects by Motorola, available free by writing Department 73, Box 20924, Phoenix AZ 85034.

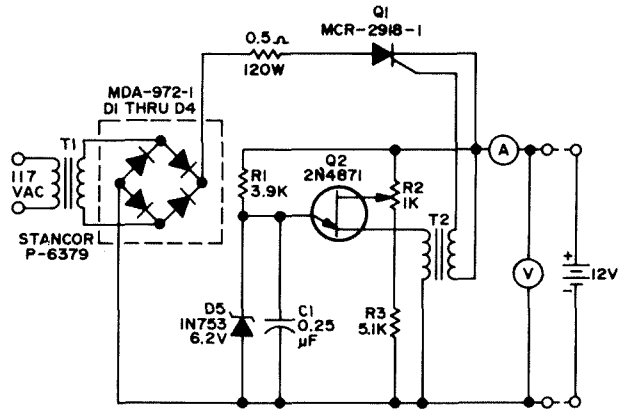


Crystal oscillator for receiver direct conversion. This oscillator will beat against an incoming signal and stay right on frequency even though yuur receiver may drift a bit. Great for RTTY autostart, net operation, and fixed frequency biz. Circuit courtesy W9ZTK, W9YPS and the RTTY Journal, Box 837, Royal Oak MI 48068. Crystal frequency = net frequency + 2.125 kHz for TT autostart. A 7075 surplus FT2243 crystal can be ground up a couple of kHz so the end result will be autostart on 7075 kHz.

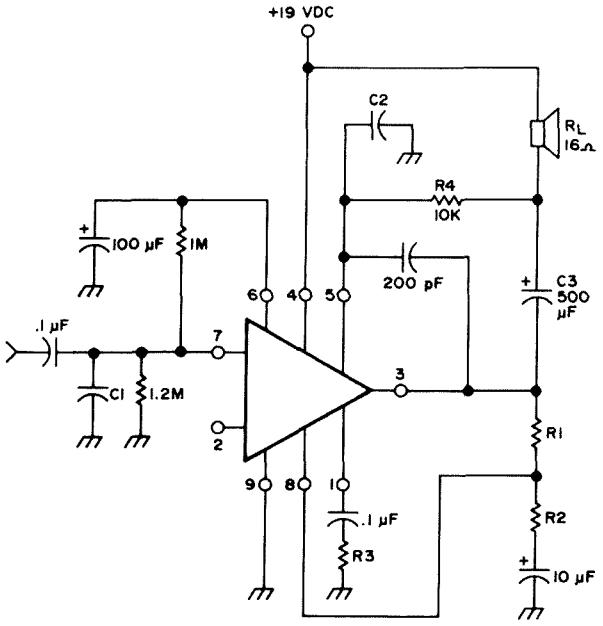


VHF amplifier used to measure gain, noise figure and AGC performance of the Fairchild FT0601 MOSFET. For AGC operation, dual-gate MOSFETs have a built-in advantage owing to their separate gates, especially in the VHF region. Amplifiers such as this one eliminate cross-modulation distortion, decrease receiver noise and avoid shifting of the receiver's center frequency. Schematic from Fairchild Semiconductor Application Note APP-189.

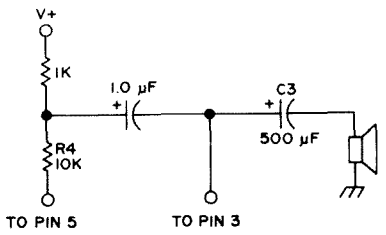
L1 = 15/64 ID, 0.8" long, 5T #18 s.p. wire, tapped at 2.5T.
L2 = 15/64 ID, 0.8" long, 4T #22 s.p. wire, tapped at 2.5T.



Foolproof Battery Charger. T2 is a Sprague 11Z12. Protects battery against overcharging or reverse charging, also protects itself against shorting or hurting another supply. Will supply 16A. Circuit courtesy Motorola Semiconductor Power Circuits Handbook.

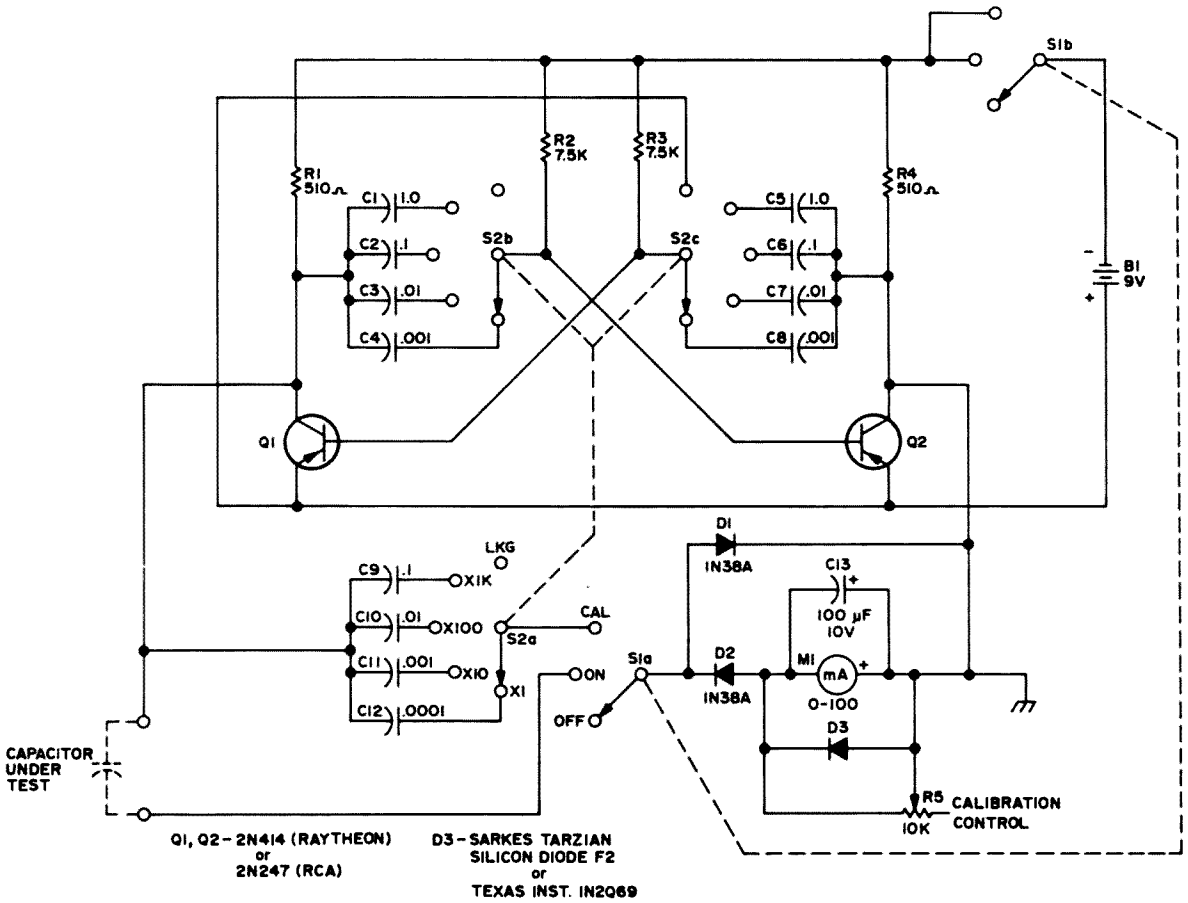


SENSITIVITY FOR 1 WATT mV	C1 pF	C2 pF	R1 k OHMS	R2 OHMS	R3 OHMS
400	0	0	10	1.0K	82
10	100	100	51	100	2.2K



Alternate connection to permit connecting speaker to ground instead of to V+.

Typical circuit for a 1-watt audio power amplifier, using Motorola's Functional Circuit MFC8010. Circuit and data from Motorola's Functional Circuits book of application notes.



Direct-reading capacitance meter. From an article by Roy A. McCarthy K6EAW, in the very first issue of 73 Magazine, October 1960.

Wave Propagation on VHF

The following chart is reprinted from Radio ZS, SARL, Box 3911, Capetown. It was prepared by ZS2FM.

TYPE OF PROPAGATION	TIME	50 MHz	144 MHz
"Ground" Wave	Daily	200–300 Miles	150–200 Miles
		Depending on terrain, power and antenna gain.	
Sporadic E	Summer months Mornings & Evenings	400–2500 Miles	1000 Miles
Tropospheric Bending. (Temp. Inversion.)	Watch the weather	400–1500 Miles	500–2500 Miles
Aurora	During ionospheric storms at night.	1300 Miles	1000 Miles
Meteor Reflection*	During meteor	1500 Miles	1500 Miles
Ionospheric Scatter*	Summer months	1400 Miles	1400 Miles
F_2 Layer	At peak of sunspot cycle	1200 Miles	

***Requires high power and high gain antennas at both ends of circuit.**

HEATHKIT MODIFIED HW-16



CW TRANSCEIVER

John N. Edgerton WA3PRV
129 Robinson Drive
New Castle DE 19720

Having built two Heath kit HW-16 CW transceivers for friends and hearing such successful reports, I decided to purchase one myself. I ordered the kit and, while it was enroute, borrowed a manual for the HW-16 from a friend.

After studying the manual and evaluating performance standards, I decided to make a few refinements. Upon its arrival, I had an outline of modifications as shown below.

- Change final tuning.
- Add variable antenna load instead of fixed load.
- Add variable selectivity.
- Add fine tuning.
- Improve transmit oscillator.
- Incorporate constructional refinements.

The fine tuning feature came as an afterthought. Because of the variable selectivity, I needed to retune my present receiver after changing from one selectivity position to another. The fine tuning also helps tune more accurately if the band is crowded.

Change Final Tune

I found that on 3.7 MHz, the HW-16 would not tune to a peak; that is, the plate tune capacitor (C28) would have to be turned to its extreme clockwise (open) position to get good output. I reduced the capacitance by changing C27 (150 pF, 4 kV capacitor) to a 100 pF, 4 kV capacitor, as shown in Fig. 1.

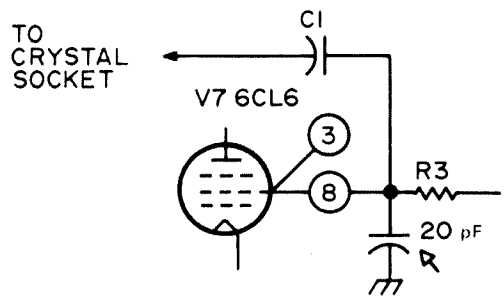


Fig. 1. Substituting a 100 pF capacitor in place of the original 150 pF value will extend the HW-16's tuning range.

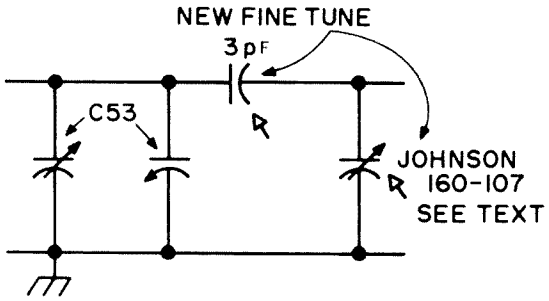
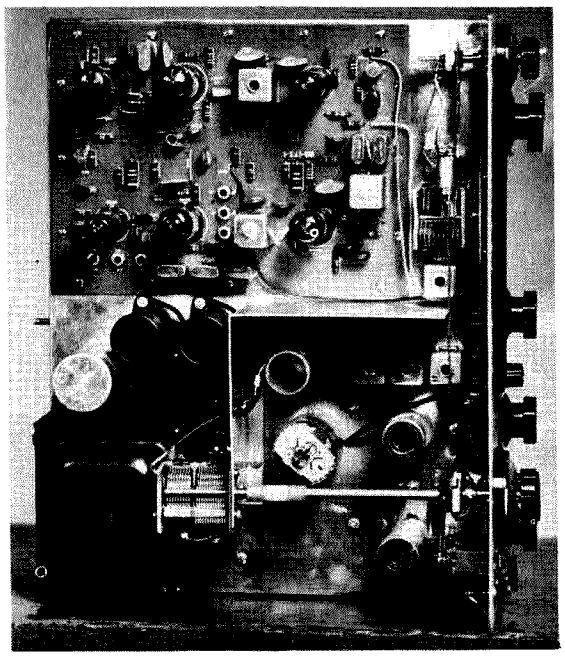


Fig. 2. A 365 pF variable from a BC radio is an ideal substitute for the original 390 pF fixed load, and allows a wide degree of antenna load adjustment.

Antenna Load Control

The HW-16 comes with fixed load on all bands. Capacitors C29, C30, and C32 comprise the loading on the HW-16 antenna circuit.



A 365 pF variable from a BC set improves the antenna loading, but it involved moving the panel meter to accommodate the vernier control.

I removed C32 (390 pF) and mounted a 10–365 pF variable capacitor above the chassis near the power transformer as shown in Fig. 2. The 10–365 pF capacitor, from a 5-tube table model BC set, improves the load to the antenna. I had to move the meter as shown in the lead photo. I also mounted a vernier dial to the panel and used a flex coupling and a plastic half flat coupling to get back to the antenna load capacitor. The center conductor of the RG-58 I used for hook-up is connected to both sets of stationary plates; the other end goes to the top terminal of the tank coil (the shield is grounded). The fact that the new variable capacitor is 25 pF less than the original does not seem to make any difference.

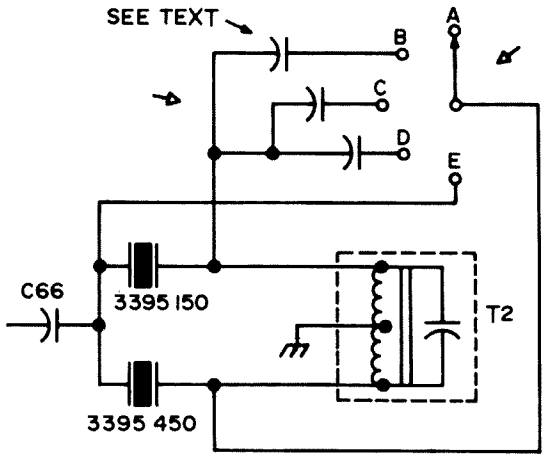


Fig. 3. A multiposition wafer switch can be used to obtain a variety of selectivity bandwidths.

Variable Selectivity

Ever try to copy CW on 40 at night? I do! Even with 500 Hz selectivity it is hard. To make this possible, I installed a 5-position selector switch at the lower right cover of the front panel. The first position (0.5 kHz selectivity) is not used (position A of Fig. 3). The second (B) puts a 15 pF capacitor across the i-f transformer. The third (C) puts a padder (which came out of my junkbox unmarked) across the i-f transformer output, and the fourth position (D) connects a .002 μF capacitor in like man-

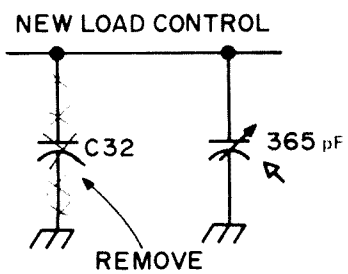


Fig. 4. A little "fine tuning" capacitor compensates for vfo shift resulting from selectivity switching.

ner. Position E puts a shunt across the 3395.150 kHz crystal, allowing me to copy a very weak station when the band is quiet. I can also copy the upper 50 kHz of 40m sideband.

Fine Tuning

I found that by switching selectivity, the receiver calibration would vary a little. I installed a Johnson 160-107 capacitor (bolted to a bracket on the pilot light support behind the main dial), and connected it as shown in Fig. 4. It is driven by a small vernier dial. The capacitor connecting the vfo capacitor (C53) and the new fine tuning capacitor is a 15 pF ceramic. I had to realign my vfo a bit after the above modification.

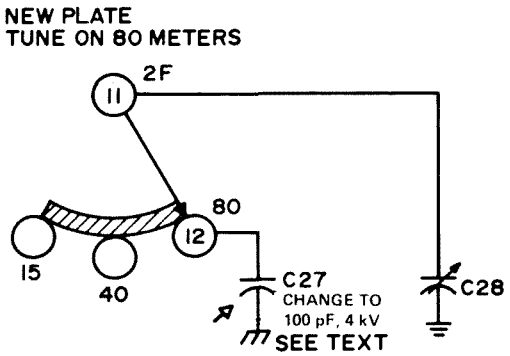
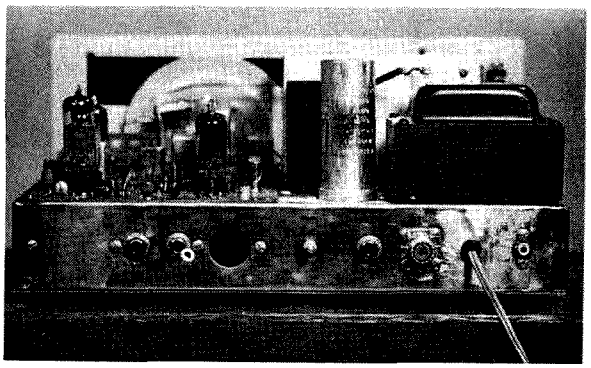


Fig. 5. A 20 pF capacitor on the HW-16 oscillator cured the problem of occasional inoperation.

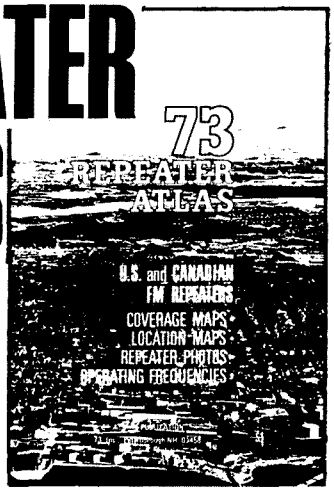


The chassis corners are darkened from brazing that was done to make the chassis sturdier.

Crystal Oscillator Improvement

Periodically, the HW-16 rigs have been known to fail to oscillate when the key is closed. Occasionally it would also hesitate long enough to make a very short "dit." To

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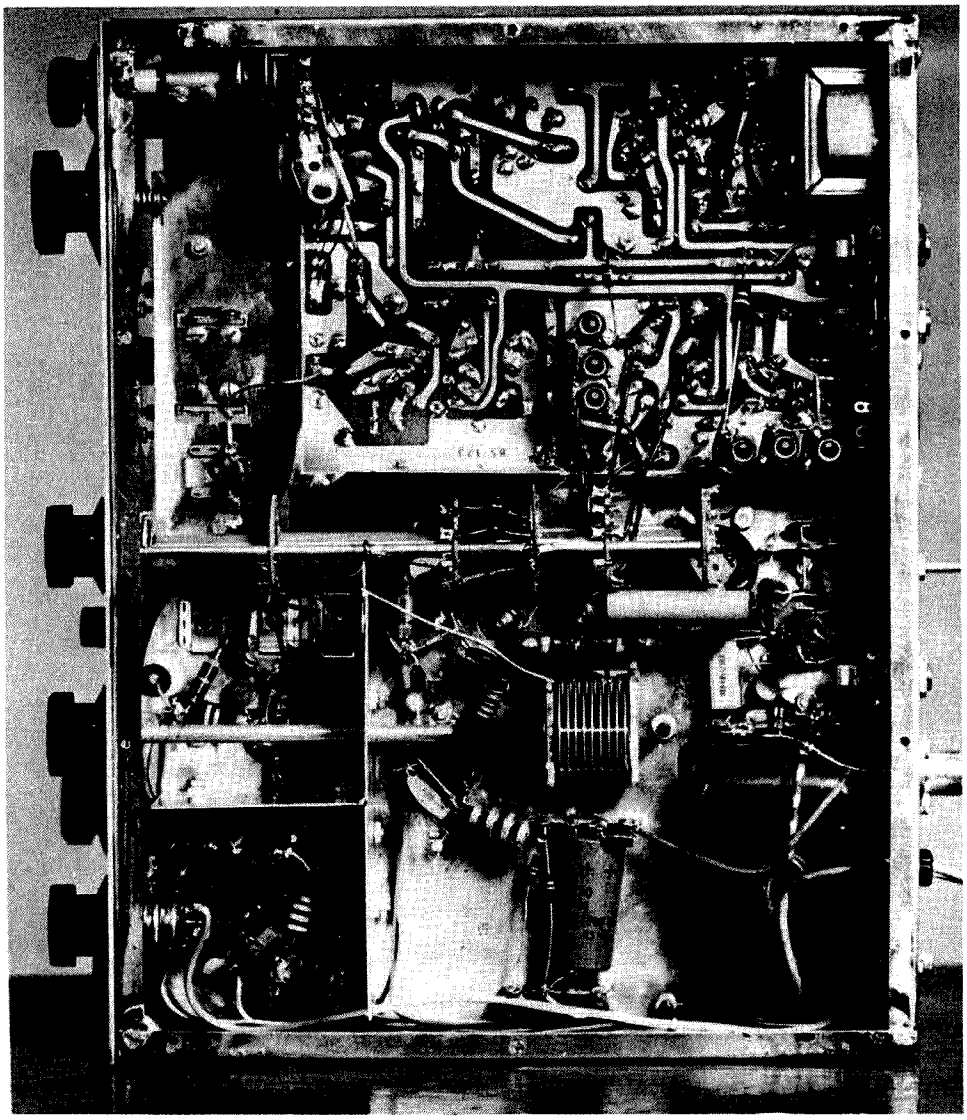
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Heavy wires between the shield and the bandswitch help to maintain a solid ground and also serve to add support to the switch.

overcome this, I put a 20 pF mica between pin 8 of V7 and ground (Fig. 5). No more oscillator malfunction!

Constructional Refinements

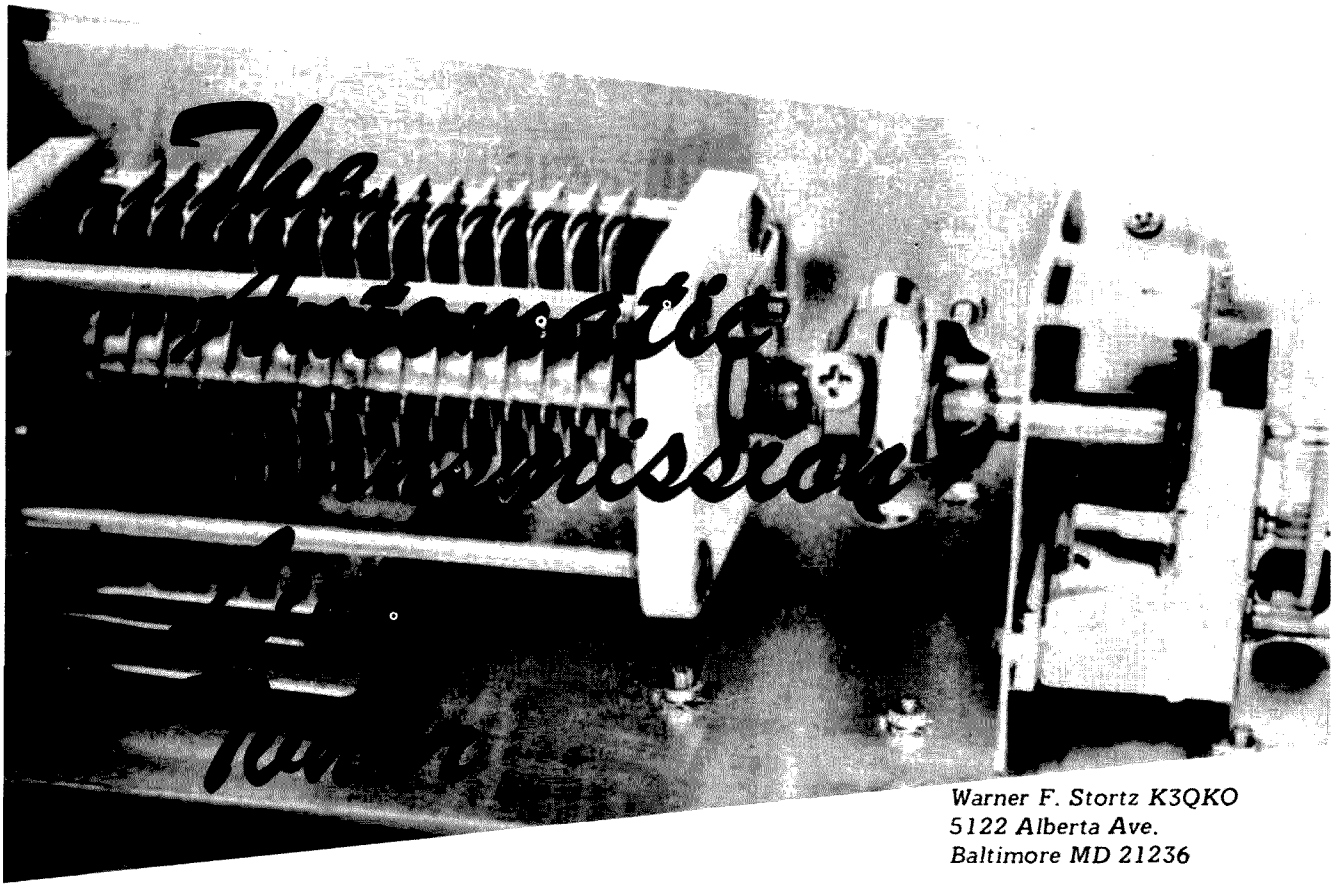
If you look at the chassis photo, you will notice the corners are darkened. This is from brazing to stiffen the chassis . . . and it works. I cut out the antenna connector hole to 5/8 in. and installed an SO-239 coax connector. I also changed the speaker jack to a standard phone jack. I bolted all terminal strips and tube sockets in place, and with a 300W soldering iron, I re-soldered all ground lugs and did the same with the C204 metal wafer plate.

I found that supporting the bandswitch at the rear made it much sturdier. I silver-soldered a brass nut to the chassis between C202 and C203 in line with the bandswitch and filed a small groove in the nut to support the bandswitch exactly parallel to the chassis. At final assembly, I soldered the bandswitch to the brass nut.

In the underchassis photo, you will notice extra ground wires soldered between the bandswitch and the shields. They also help to sturdy the bandswitch.

I wish to express my gratitude to Mel (W3KET), who helped me a great deal with technical advice – also to Donaghey Brown, a photographer with the News-Journal Co., Wilmington, Delaware, who did the photo work for this article.

. . . WA3PRV■



Warner F. Stortz K3QKO
5122 Alberta Ave.
Baltimore MD 21236

Reducing aggravations around the shack is a job that keeps the average homebrewer happily scheming and building throughout his hamming life. At the top of the "bother" list is the matchbox that must be readjusted after you make a large frequency change within a band, and the box is located on the other side of the power lines, in your garden tool shed. Anyone that has put up with this problem for years, must have wondered as I did, if you could tell your hand which way to turn the knob on the matchbox by watching the vswr meter, why can not the signal that deflects the meter do the job for you.

While working on the problem of getting the meter to twist the knob, it was soon discovered that the mismatch defying adjustment at the transmitter is the one that causes a reactive current to appear at the load end of the transmission line. A resistive mismatch as large as 3:1 causes little fuss and can be tuned out with ease. For this reason, the change in the resistive load presented by the same antenna at different locations in a given band is not large enough to require an adjustment, so one setting of the matchbox input loading capacitor is good for the entire band. This is not true of the output capacitor. It must be reset to bring the antenna–transmission line combination back into resonance, or a large inductive or capacitive phased current will be reflected back to the transmitter along the coaxial cable. It then follows that only one shaft requires adjustment after a frequency change is made, and if any change in the phase relationship of the current to the voltage in the coaxial cable at its load end could be detected and converted into a dc voltage, this signal could become the start of the automatic control that we are looking for. Such phase changes can be detected and converted into rotary motion!

The automatic transmission line tuner, whose name we will shorten to ATLT, is designed as an outboard unit to work in conjunction with a simple matchbox of the fundamental type described in most handbooks. Figure 1 shows how it is used in a typical antenna feed system. The matchbox consists of a small input coil that has a

loading capacitor in series with it and ground, inductively coupled to a large parallel-tuned coil which has the balanced transmission line fastened to it by means of taps. The ATLT uses a variable capacitor connected across the matchbox output to make any corrections that might be required to maintain resonance as the transmitter frequency is varied. It will maintain the coaxial cable vswr to better than 2:1 and will operate in the 80, 40, 20, and 15m bands. Transmitter inputs can be as small as 90W, or as high as its variable capacitor will handle. The highest power used during tests was 800W, the top input of my rig. The unit is battery powered and the design is such that no current of a magnitude that can be detected on a 50 μA meter will flow without the presence of an rf signal. This feature allows unattended operation in remote locations with battery life going into months. The servomechanism is not made in a machine shop. It came out of a battery-powered toy automobile and works like a million dollars instead of two.

The way the ATLT circuits work could be called clever, but never complicated. There is an element designed to pick up the coaxial cable current (L1, Fig. 2) and transform it into a useful signal that can be summed with the cable voltage, much reduced in amplitude. The resultant of these two signals, detected by diodes, produces a dc voltage that is positive, negative, or zero, depending upon the phase relationship of the current to the voltage. This circuit is known as a phase-sensitive demodulator and is the ATLT nerve center.

Current coil L1 is a laterally wound coil that encircles the coaxial cable inner conductor. When the alternating current through the cable increases, decreases, and then reverses direction, an expanding and contracting magnetic field is produced, inducing a potential across this coil. This voltage is 90 degrees out of phase with the cable current because of the electrical law stating that magnitude of a voltage induced into a conductor by an electromagnetic field is directly proportional to the rate of change of this field. When the current, alternating from its peak negative to its peak positive value passes through the zero point, the rate of change is at its maximum and is displaced by 90 degrees from either current peak.

Without the voltage signal present, the rectified currents out of the ends of L1, through CR1 and R2, CR2 and R1, and back to its centertap, will be equal in each circuit branch. This produces a zero potential difference across the R1-R2 divider. The primary voltage signal path is through R3, to the centertap of L1 and out its ends, through CR1 and CR2 to ground. C1 provides an ac ground to both ends of the R1-R2 divider, plus smooths the pulsating dc. The secondary path through R4, R5, and C2 reduces the voltage applied to L1 and allows small phase corrections to be made to it. When the voltage signal is present, it will add to or subtract from the current signal, depending upon their phase relationship. If the voltage and current signals are directly in phase, then across one coil of L1 they will add while across the other they will subtract. Unequal currents will flow through R1 and R2 creating a potential difference across the divider. If the phase is changed 180 degrees, this potential will be of the same magnitude but of opposite polarity. When the signals are phased 90 degrees to each other, right in the center between 0 and 180 degrees, equal currents again flow and there is no potential difference. The voltage signal, applied to this phase-sensitive demodulator, is not shifted from its original phase, while the current produces a signal that is shifted 90 degrees. Therefore, when the coaxial cable voltage and current are in phase (unity power factor) there will be no demodulator output measurable across J3 and J4. Any small change in this phase relationship will result in an output that will be either positive or negative, depending upon whether the angular difference is leading or lagging.

The demodulator output is applied between the base and the emitter of Q1 and Q2. Q1, being an NPN transistor, will be switched on when the output is positive, and Q2, a PNP, will turn on when it is negative. Both transistors are operating class C and require about 0.5V of signal

before either will conduct. Q1 and Q2 are direct coupled to Q3 and Q4. Either one or the other can be switched on, actuating K1 or K2, depending upon the state of the demodulator output. K1 and K2 are high-resistance, low-coil current relays with their contacts wired so that a high-current positive or negative, 3V dc output is made available to operate the servo motor, which positions variable capacitor C4. C4 is connected across the matchbox output and will automatically be repositioned every time the power factor in the coaxial cable changes from unity, bringing the antenna system back into resonance.

The reversing switch (S2) is used to eliminate the construction problems that would be brought about by trying to keep all phases and outputs aligned so that the servo motor will turn in the correct direction when called on to make an adjustment of C4. A complicated switch of this type is not needed if C4 does not have stops and will rotate 360 degrees. This is because C4 can be turned in either direction to its correct location.

A homemade fixed capacitor (C5) is used during 15m operation to prevent "hunting." Hunting is the oscillating motion of the servomechanism about null that takes place when variable capacitor C4 coasts through the null point after the motor power drops to zero, causing the demodulator to produce an output that drives the motor in the opposite direction, where it coasts past null again repeating the whole process. Series connected C5 makes it necessary for C4 to move a reasonable number of degrees to make an effective adjustment.

The ATLT is assembled on a 2 in. chassis of about 5 by 7 in. area. The front and rear panels are across the narrow ends of the chassis and are 5 in. high with rounded corners. The cover is a wrap-around type that snaps in place by holes in its lower side picking up the protruding heads of screws mounted in the chassis. Easy cover removal is necessary unless some sort of dial is provided to indicate the rotor position of capacitor C5. The front panel controls are: *phase* potentiometer R4; *amp* and *servo* switches S1 and S2; *demod* and *sig gnd* jacks J3 and J4.

Connections to the fixed and variable capacitors (C5 and C4) are brought through the rear panel using high-voltage ceramic feedthrough insulator posts. A shield, run down the center of the chassis, provides a place to mount the battery holders. The one for the 9V batteries is made of thin aluminum, while the 1.5V cells are held in the battery box removed from the toy auto which also provided the necessary motor gearbox assembly.

The current pickup coil details can be seen on Fig. 3. A piece of RG-8/U coaxial cable is cut so that it is long enough to be

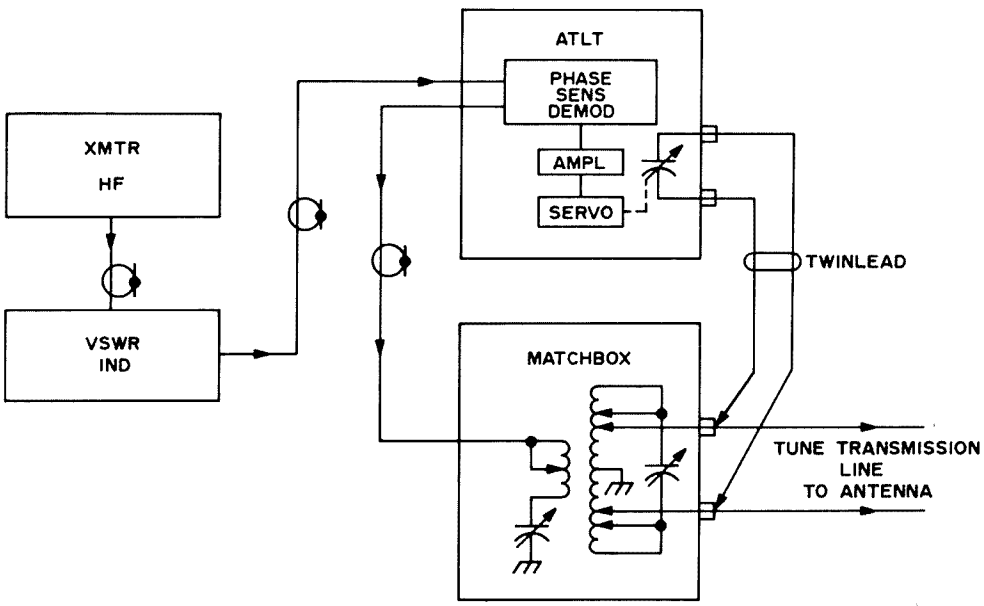


Fig. 1. Block diagram.

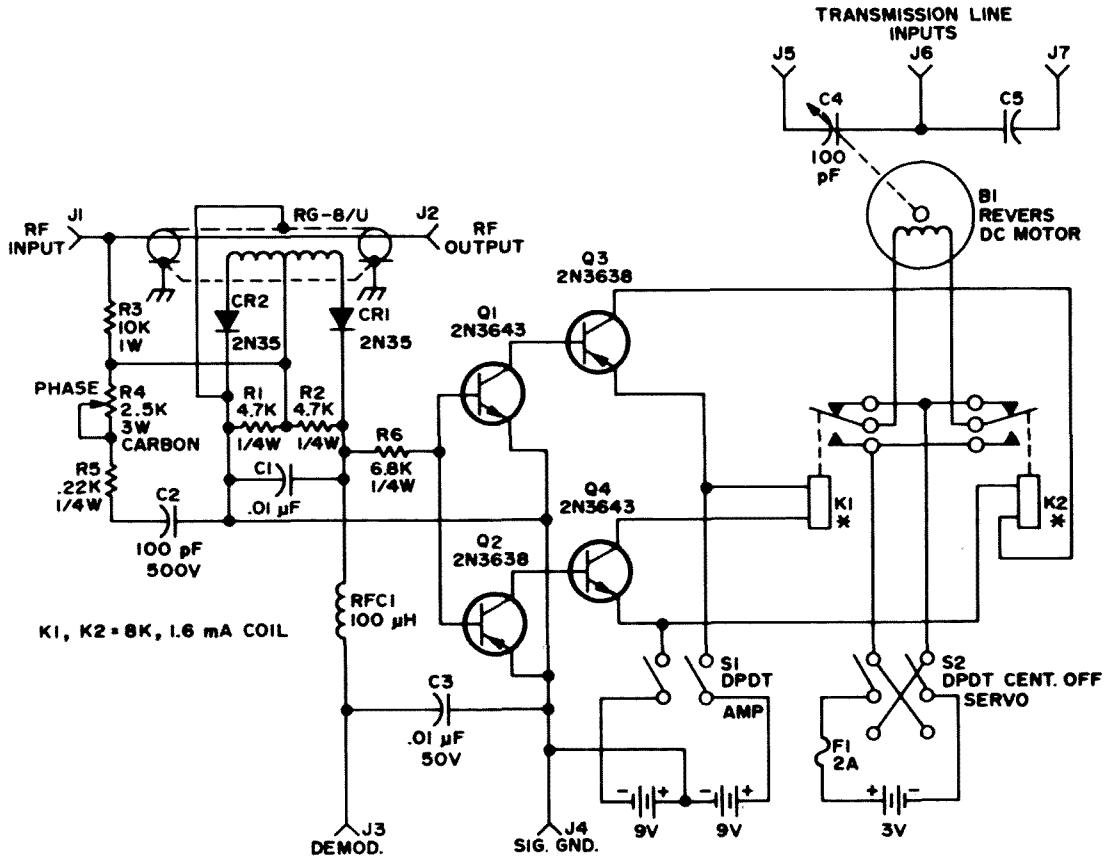


Fig. 2. Schematic — ATLT Unit

soldered between box connectors J1 and J2, located either side of the chassis at the back. The outer insulating jacket is slit lengthwise and peeled off in one undamaged piece, because it will be used for a form for L1. The braid is also pushed off undamaged so it can be later replaced. The outer jacket insulating material is wrapped around the insulated center conductor and trimmed so that it will fit snugly without overlapping. Its length is trimmed to 2 in. and a hole is punched in its end either side of the slit for the coil leads to pass through. Seventeen bifilar turns of 28-gage enamel wire are wrapped around the jacket material lengthwise. (Seventeen bifilar turns are equal to thirty-four single turns.) The start of coil B and the end of coil A are twisted together. These leads will make the centertap when they are soldered. The other leads, along with the centertap, are slipped into an insulating tube, and the completed L1 is thinly taped around the insulated coax center conductor. The braid is expanded and slipped back over L1 and the center conductor, fishing the L1 leads out through a hole worked into it about ¾ in. from one end. The whole thing now looks like a short piece of RG-8/U without its outer jacket, and a small lump where L1 is located under the braid. The tubing, with the L1 leads in it, will be coming through the braid at one end of this lump, and when the current pickup assembly is soldered to the box connectors, this end will be near J2. The braid ends are wrapped and soldered to one turn of bare wire, and these wires are connected to two ground lugs at each connector shell.

Constructing a servomechanism turns out to be a lot less frightening than first thoughts make it seem. In fact, it is quite a satisfying experience using the old Yankee know-how to get the machine to run. Timer assemblies make excellent servomechanisms for this application, but require power sources not readily portable. Luckily, battery-powered motor-gearbox assemblies abound in any toy store. There are more snappy battery toys made today than one who has been away from such things has a right to realize.

There is no reason for not being selective about picking out a toy that operates

rather slowly, and has an easy to-get-at drive assembly. I settled for a model of a Ford Mustang. The complete title on its box is "*Non-Fall Mystery Bump'n Go Ford Mustang GT-41*". It is an all-metal model, and runs relatively slow to the edge of a table and then, before dropping off to the floor, it turns itself around and proceeds back over the table again as if it had eyes.

The metal construction makes it easy to take apart, because it is held together with metal tabs bent over here and there. The motor and gearbox, along with the rubber drive wheel, comes out in one piece after straightening a few tabs. It will require minor modification before a ¼ in. shaft can be mounted to it.

The electronics is built on a perforated Vector board and arranged to look neat. The transistor types can be changed to practically any silicon NPN and PNP type and still work fine. The balanced 2N35 diodes are rather old-fashioned and can be replaced by other types if you pick a pair that have equal conduction. I do not know the brand of the scrounged relays, however, they have 8 kΩ coils and will operate with 15V across them. The circuit board is mounted on spacers under the chassis and wired to the switches, jacks, L1, and signal ground (which is a point on the coax braid over the center of L1); R3 is connected to the center conductor of J1.

C5, the homemade fixed capacitor, is made from a U-shaped square (1½ in.) of aluminum. The top of the "U" end is trimmed ¾ in. deep so only the lower ½ in. of it is left. This portion is drilled and bolted to the 15m (bottom) feedthrough post. The center plate is a 1½ x 2 in. right angle shape with a ½ in. flange. The lower portion of the flange is trimmed like the "U" so it will clear the 15m feedthrough post. The tab that is left is connected to the center post that also feeds the stator of C5. The plates of the capacitor are bent until they are spaced ¼ in. from each other.

Before operating the completed ATLT, a few precautions should be taken. The plate spacing of C5 is about .070 in. This makes it necessary that the length of the tuned transmission line be selected so that a very high voltage will not wind up at the matchbox output. Remember, a quarter-wave line inverts the load connected to it, and a half-wave line will repeat it. Be careful that rf does not get into the unit from the test meter, or indications will be erratic. Check that the transistors do not have a current flow before an rf signal is present. Keep in mind that the ATLT will detect and correct *only* reactive power conditions in the coaxial cable, so the vswr indicator can be indicating a high vswr of a resistive nature that will not be seen by the ATLT. The resistive mismatch must be tuned out with the matchbox input capacitor, but only one time for each band.

After the above checks are made, connect the ATLT in series with the coaxial cable running to the matchbox input, along with a vswr indicator ahead of it. Connect C5 across the matchbox output using a short piece of TV twinlead, and set the rotor halfway open. Load the matchbox with a lamp so that its output capacitor

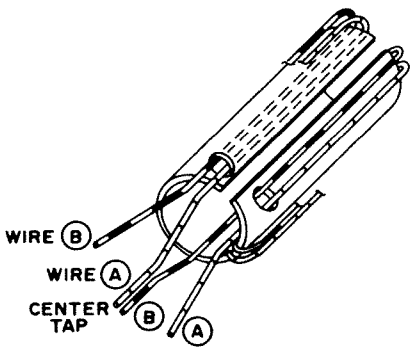
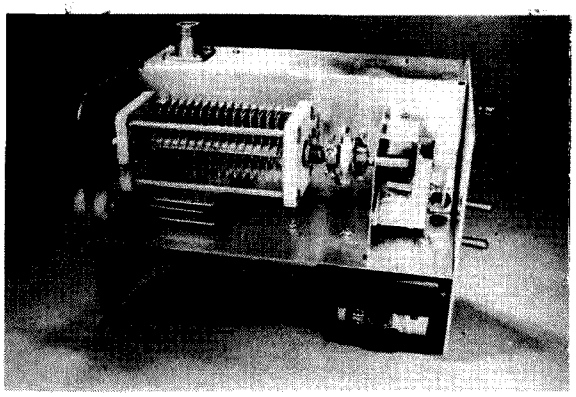


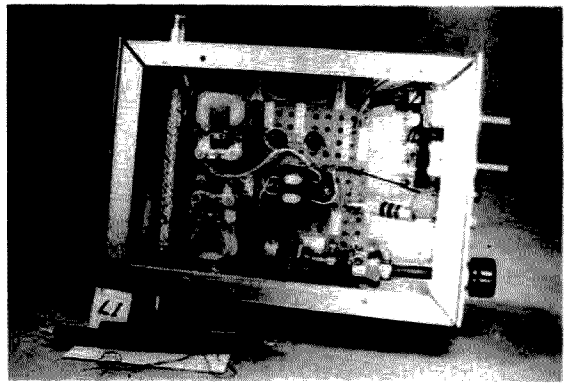
Fig. 3. L1 construction is on 2 in. long RG-8/U casing; 17 turns (lengthwise) of 28-gage enamel wire.



The automatic transmission line tuner connect to the matchbox.



The ATLT, top view.



The ATLT, bottom view.

will tune rather sharply (coil loaded to a medium Q). Set all ATLT switches off, and apply a 40 or 80m signal to the setup. Adjust the matchbox for optimum output.

Rotate *phase* control R4 to the center of its travel. Measure the demodulator output between J3 and J4 using a 20 kΩ/V meter, and readjust the *phase* control for a null indication. Move the matchbox output capacitor slightly one way and then the other from the set position and the meter will indicate a potential, a null when returned to set, and an opposite polarity potential when on the other side of set. Place the *amp* switch S1 on. K1 and K2 will click on and off as the capacitor is rotated through null.

Place the *servo* switch S2 on and the servomechanism will relocate variable capacitor C4 to compensate for these position changes. If C4 drives against one of its stops, set the *servo* switch to its other position and the motor will drive in the correct direction to produce a demodulator null. When the transmitter frequency is changed, C4 will be driven open or closed as the frequency is increased or decreased, and the vswr indicator will indicate a low ratio.

C4 is not a large capacitor and with some matchboxes it might not be capable of adjusting throughout the entire spectrum of the lower bands, but it most certainly will cover whole CW or phone portions. Try the setup on the other bands, using C5 in series with C4 on 15m. If trouble is encountered, the ATLT may be tested like a vswr indicator by connecting a dummy load to coaxial box connector J2. Under this condition the demodulator output should be less than 0.5V.

After these tests are completed, the ATLT is ready to be connected to the antenna feed system as shown in Fig. 1. It will operate just like it did during bench tests, correcting for all transmitter frequency changes large enough to cause objectionable standing waves along the coaxial cable.

This method of antenna tuning, to my knowledge, is new but as reliable as a vswr indicator. It is tuning a center-fed 33 ft antenna for me with wonderful results on all bands. (The 33 ft distance is the space between two nicely positioned trees and not meant to be some magic length that produces red hot results.)

I guess that it is obvious by now that C5 could have been a roller inductor at the base of a short vertical antenna, continuously adjusting it over the whole band, or the servomechanism could be rotating the matchbox capacitor instead of an outboard unit. What may not be obvious is that this idea can be expanded to include the automatic tuning of tank circuits by placing L1 in one of the circuit leads and shifting the voltage signal 90 degrees before it is summed with the current signal. By using varactors and motors I believe an entire transmitter could be automatically tuned. This is one of the most exciting projects I have worked on: real automatic fedback control of rf. ...K3QKO■

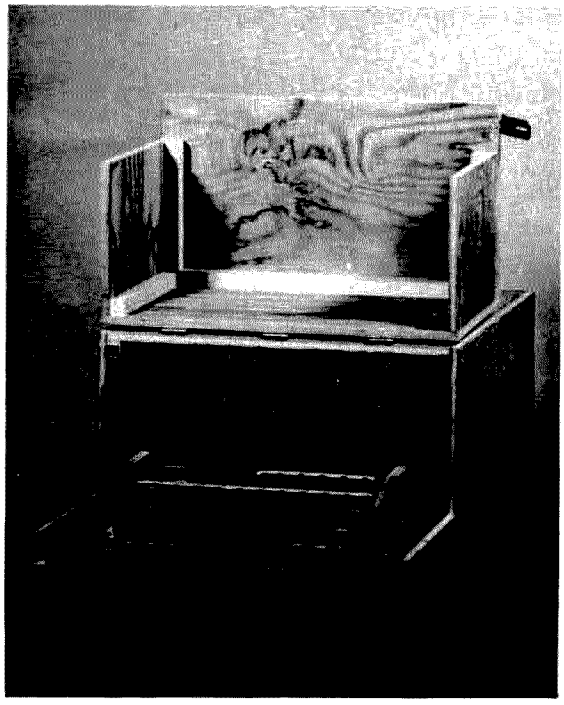
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The Button Box

An automatic morse code generator driven by a keyboard for better sending by everybody

The *button box* is another version of a keyboard code generator, and discloses no new and startling techniques. In presenting the button box, I intend to introduce you to digital logic, describe the logical operations involved in generating the code, and give you some ideas for building your own. Nothing in the descriptions or drawings is sacred or critical, and were intended not for duplication but rather to arm you with enough information to combine your ideas with mine and build a unit that will fulfill *your* requirements.



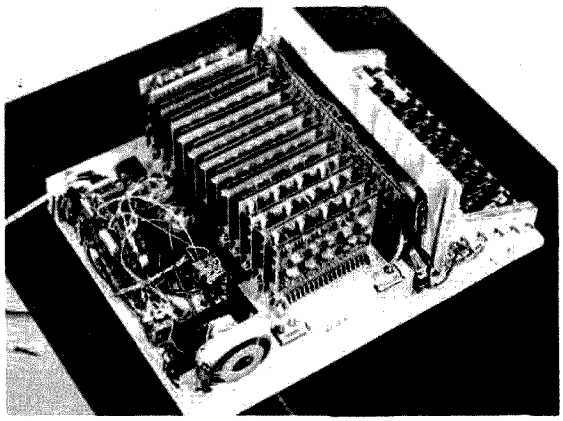
THE BUTTON BOX

Keyboard articles by Horowitz (QST, Aug. '64 and Oct. '68), Granberg (CQ, Sept. '64), and Bryant (QST, July '69) are all excellent and recommended reading. Each of the keyboard units described in these articles has its advantages, and perhaps by combining portions of each, one could devise the ultimate in compactness and versatility. However, I find it difficult to use components that I do not understand well, and prefer to use old "tried and true" discrete components. By using these, I can get by without a scope (in most instances), and can measure almost any point in the logic with my voltmeter.

In dreaming up the button box, several problems confronted me: First, money was not too plentiful. The bargain ads consulted for components revealed that surplus computer cards could be bought quite reasonably and either used as-is or stripped for the components.

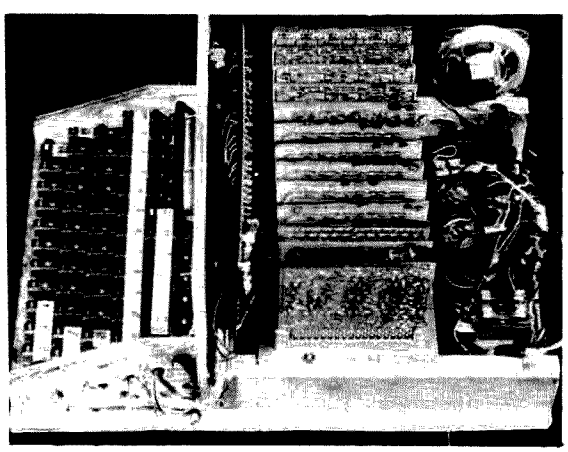
Secondly, I am no craftsman, and had only a few hand tools to use in building the keyboard. I used plywood to build the button box, but Masonite, aluminum, or whatever your favorite material is, could be used. The keyboard switch problem has been solved a number of ways, but I took the easy way out when I found a bargain sale on "micro" switches.

Last, but far from least, I wanted the logic to be straightforward, and the parts mounted so they would be accessible for repair or modification. I have justified this approach by making a number of changes



In this view of the button box, the discrete components are shown on their plug in PC cards. The power supply and speaker, not modular, are shown at the back of unit.

and circuit additions that I would not otherwise have been able to make. Most of the additional circuitry is for station control and does not affect the button box itself, so will not be discussed here. Each button controls an encoder gate that uniquely defines the character to be generated. This approach, although using additional diodes, simplifies the tracing of troubles in case a component becomes defective. Since the last bug was tracked down and slain in April 1968, only one problem has developed to test this theory. A transistor in an input *nand* gate proved to be sensitive to the heat of our July, and was promptly located by listening to the errors caused in the code. Verification that the culprit had been found was made using an ohmmeter, and a lighted cigarette as a spot heat source. Replacing the transistor took but a few minutes, and no troubles have developed since that time.



Detail of keyboard and wire routing method.

Advantages

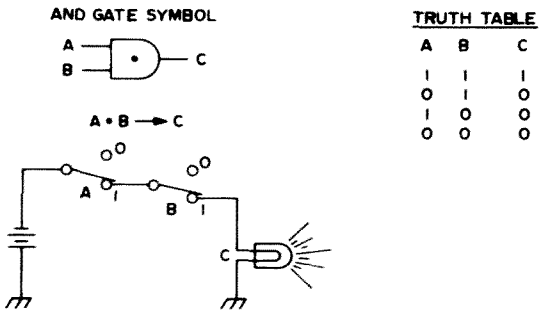
Expending so much time and even a little money just to build a unit to replace the hand key hardly seems justifiable, and may appear somewhat ridiculous to the uninitiated. Even if that was the sole reason, it would be worth the effort to put better, more readable CW signals on the air, but there are other uses for the button box which have little to do with on-the-air operation.

It is great for code practice sessions, either on or off the air. The built-in monitor can be made loud enough for room use, or feed separate jacks for use with headphones. Individuals, or groups, can learn the code without any prior training or CW knowledge, because as each button is pushed, a character is generated. The sound of that character is associated with the legend inscribed on the button, so there is little chance for error. Any speed wanted can be accommodated, and double characters, repeats, or combinations can be sent without the problems associated with disk or tape recordings.

An advantage not to be overlooked, and one that is important to me, is that those of us with an infirmity or physical defect that makes it difficult to use a straight key, bug, or keyer-paddle can now send beautiful code by using only one finger if necessary. Loss of the thumb on my paddle-wielding hand curtailed my CW activity until I completed the button box. Now I get compliments on how nice my "fist" sounds, and I enjoy CW more than ever.

Who???

NNGT is often heard on the CW band. No – this is not a ship at sea operating on the wrong frequency, but is what all-too-frequently passes for CQ when the fellow sending has a really swinging fist. Or, how often do you hear NST? Of course he really means TEST, but then, everyone knows that – or do they? Poor CW is always a problem with the *other fellow* – never ourselves. With a button box you can be certain that you are not the *other fellow* but the one who actually "sounds better than tape."



TRUTH TABLE

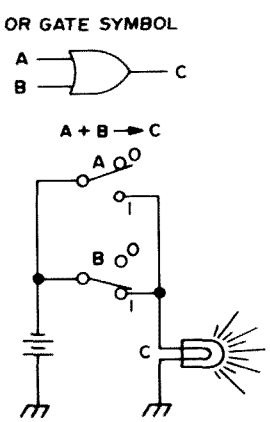
A	B	C
1	1	1
0	1	0
1	0	0
0	0	0

Fig. 1. The switches show the mechanical equivalent of a typical and *gate.*

Introduction to Logic

If you have read this far, you are seriously interested in building a button box, so let's review the logic elements that are used as building blocks and dispel the aura of mystery that seems to surround these computer circuits.

In the discussion of a specific circuit design, it is necessary to define logic levels in terms of voltage. However, when using logic symbols and describing logical operations, only two conditions concern us: (1) either a statement is true; (2) or a statement is false. The binary system consists of only two states, and is regularly applied in daily life. For instance, a light bulb is either on or off, it is day or night, or a door is open or closed. "The light is on" is a statement of fact, and we can assign a symbol such as **A** to indicate that the bulb is indeed on. However, if the bulb is not on, we do not need another symbol to say so, but we should define the condition when **A** is not true (false). We can do this



TRUTH TABLE

A	B	C
1	1	1
0	1	1
1	0	1
0	0	0

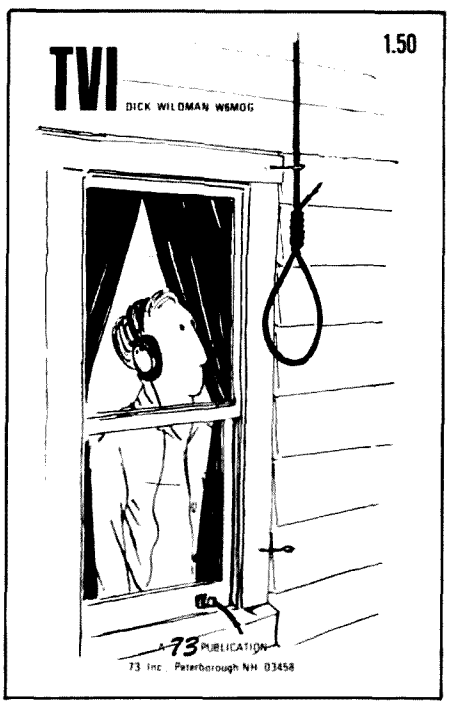
Fig. 2. Paralled switches make a mechanical equivalent of the or *gate.*

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by putting a bar over the A and saying $\bar{A}$ (read as "A not") means the bulb is not on. We have defined the two possible states of the bulb as A for on; $\bar{A}$ for off.

We can apply this logic to any fact and make a statement that is true (A) or false ($\bar{A}$). It is easy to decide which state exists in binary notation if we use the figure one (1) as the true state and we use zero (Ø) as the false state. This binary notation allows A to assume either the 1 or Ø state, and $\bar{A}$ will be the negation, or inverse. If we were to say, "The light (A) is on," and the light is really on, the statement is true and A equals 1. However, if the light is really off, then the statement is false and A equals Ø.

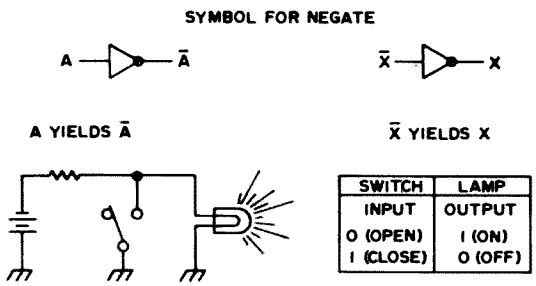


Fig. 3. A simple inverter can be used to negate a logic function.

We may also make a statement of negation. By saying, "The light is not on," the statement will be true when the light is off, and $\bar{A}$ will be equal to 1. These terms, once defined, are often used interchangeably in describing logical operations.

By combining logical conditions in gates, we can produce an output at any time, or in any sequence that we may desire. We can amplify, invert, combine, store, or compare logic levels by using gates and flip-flops. Logic symbols and operations will be described before we get into the operation of the button box, so if at present you are thoroughly confused, don't despair, for now that we know what a logical statement is, let's see how we can shorten it to symbols that when interconnected can tell us how something works.

The AND Gate

An *and* gate must have all of its inputs true in order for the output to be true. If we combine soil "A" and water "B", the result is mud "C". This statement may be

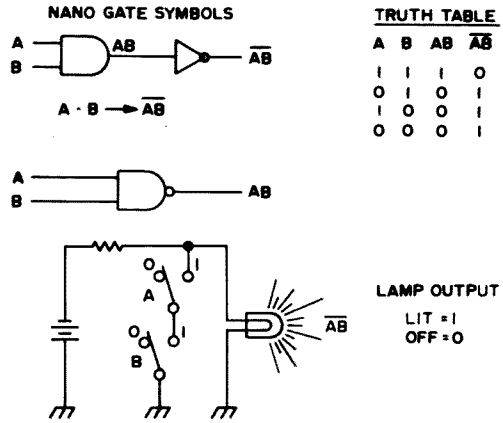


Fig. 4. The nand gate is an and gate whose output is negated. The switch arrangement shows a mechanical circuit equivalent of a typical nand function.

written as A•B→C, or simply AB→C, and is read A and B yields C. Switches can be used to more clearly show the operation of an *and* gate (see Fig. 1). Conditions of the inputs and outputs in the truth tables show the relationships.

Examination of Fig. 1 will show that only when switches A and B are both closed will the light C be turned on. We can say then that in *and* gates, the key word to remember is *all* and that all inputs must be at the true (1) level to produce a true (1) output. Also, the *control* for the *and* gate is Ø, since any Ø at the input will cause the output to be false (Ø).

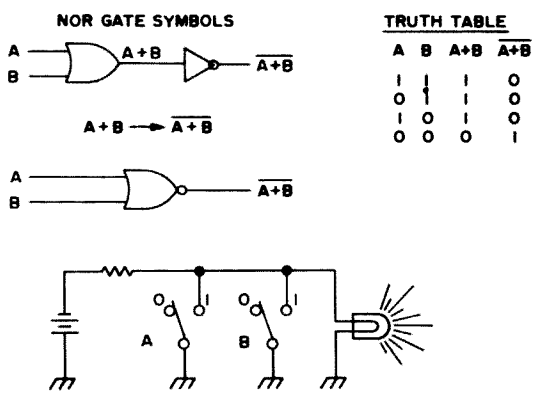


Fig. 5. The nor function, as shown by the switch assembly, produces a negated result (light goes out) when any input is at 1.

The OR Gate

The *or* gate performs a logical function by allowing a true output whenever one or more of the inputs are true. The *or* function is designated by the + sign. The

statement A + B → C is read A *or* B yields C. Operation of the *or* gate can also be seen by examination of the relationship of the inputs to the output in the truth table of Fig. 2.

It can be seen in Fig. 2 that when either, or both, of the switches close, the light will be on. We can say of the *or* gate that *any* is the *key word*, and that if *any* of the inputs are at the true (1) level, the output will be at the 1 level. We may also say that the *control* is a 1, since any 1 at the input will cause the output to be a 1.

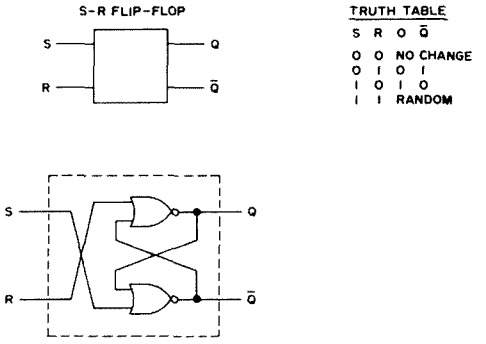


Fig. 6. Cross connected inverting gates form flip-flops that operate similarly to the manner of a latch relay.

Invert/Negate

To negate a function, an inverter is required. If A is the input to an inverter, the output will be $\bar{A}$. The symbol and function are shown by Fig. 3. Quite a few of the logic boards available on today's surplus market do not use the direct *and/or* functions, but have an inverter following the gate. If the function is not understood, these can cause problems in implementing the logic to create the desired output.

The NAND Gate

The *nand* function is the *and* function negated, or the contraction of "*not and*".

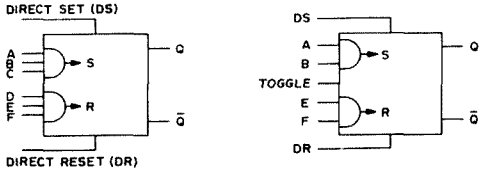


Fig. 7. Multipurpose flip-flops may have a number of triggering inputs, selected to match the requirements of specific circuits.

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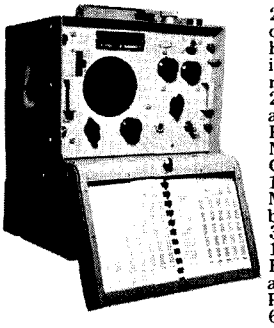
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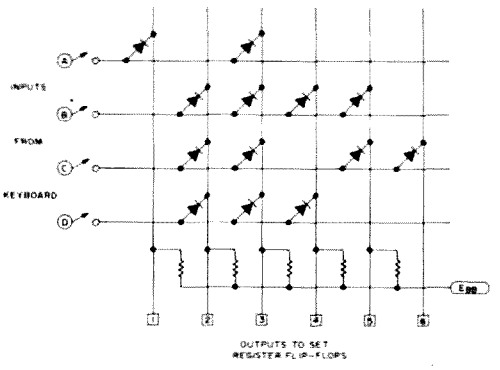


Fig. 8. The encoder, or matrix, causes simultaneous outputs with but a single input signal.

To understand the operation of the *nand* gate, note that the *and* function at the input must be satisfied to cause the $\emptyset$ output, represented by extinguishing the lamp of Fig. 4. The *nand* gate yields a 1 output until *all* inputs are at the 1 level. The *key word* in a *nand* gate then, is all, because all inputs must be at the 1 level to produce a $\emptyset$ (negation of *and*) at the output. Since any $\emptyset$ input will cause the output to be a 1, the control is a $\emptyset$.

The NOR Gate

The *nor* function is the *or* function negated, or the contraction of "*not or*." In Fig. 5, note that when the *or* function is satisfied, the *nor* output of $\emptyset$ is indicated by extinguishing the lamp. The *nor* gate yields a $\emptyset$ output until none of the inputs are at the 1 level. The *key word* in a *nor* gate then, is *none*, and since any 1 will yield a $\emptyset$ output, the *control* is a 1.

Flip-Flops

Nor gates and *nand* gates are often cross connected to form a stable set-reset (S/R) flip-flop. An input pulse to either the S or R inputs will cause a condition in the output that will not change with additional input pulses applied to that same input line (Fig. 6).

By utilizing *and/or* gates to route the input signals, the simple S-R flip-flop may become a multipurpose flip-flop and can be used not only for storage, but as binary dividers, counters, shift registers, and other uses, such as oscillators, phase shifters, etc. The symbol for a multipurpose flip-flop

differs from the S-R only by the number of inputs shown (see Fig. 7). Flip-flops can be series connected and used for serial shift registers, such as the one used in the button box.

Encoder

An encoder is variously called a matrix, an expander, a coding gate, and other names – but regardless of terminology, the function is to cause simultaneous events on a multiple output with a single input signal (Fig. 8). A single input, such as closing the switch for the letter C, will cause outputs on corresponding lines – in this case, lines 2, 3, 5, and 6.

The layout for the diode matrix board used as an encoder in the button box is shown in Fig. 9. Each of the encoder inputs comes from a separate keyboard switch. Closure of any switch will cause an output on one or more of the ten lines feeding the input gates to the shift register (*and* gates in Fig. 10; *nand* gates in Fig. 12). Setting a stage of the shift register tells the code generator (CG) when to turn off.

The matrix board can be etched at the kitchen sink (send the wife to the movies while you do this), and holes drilled to pass the diode lead through the board for gate wiring, or you can use predrilled Vector board. A sheet of either is adequate as long

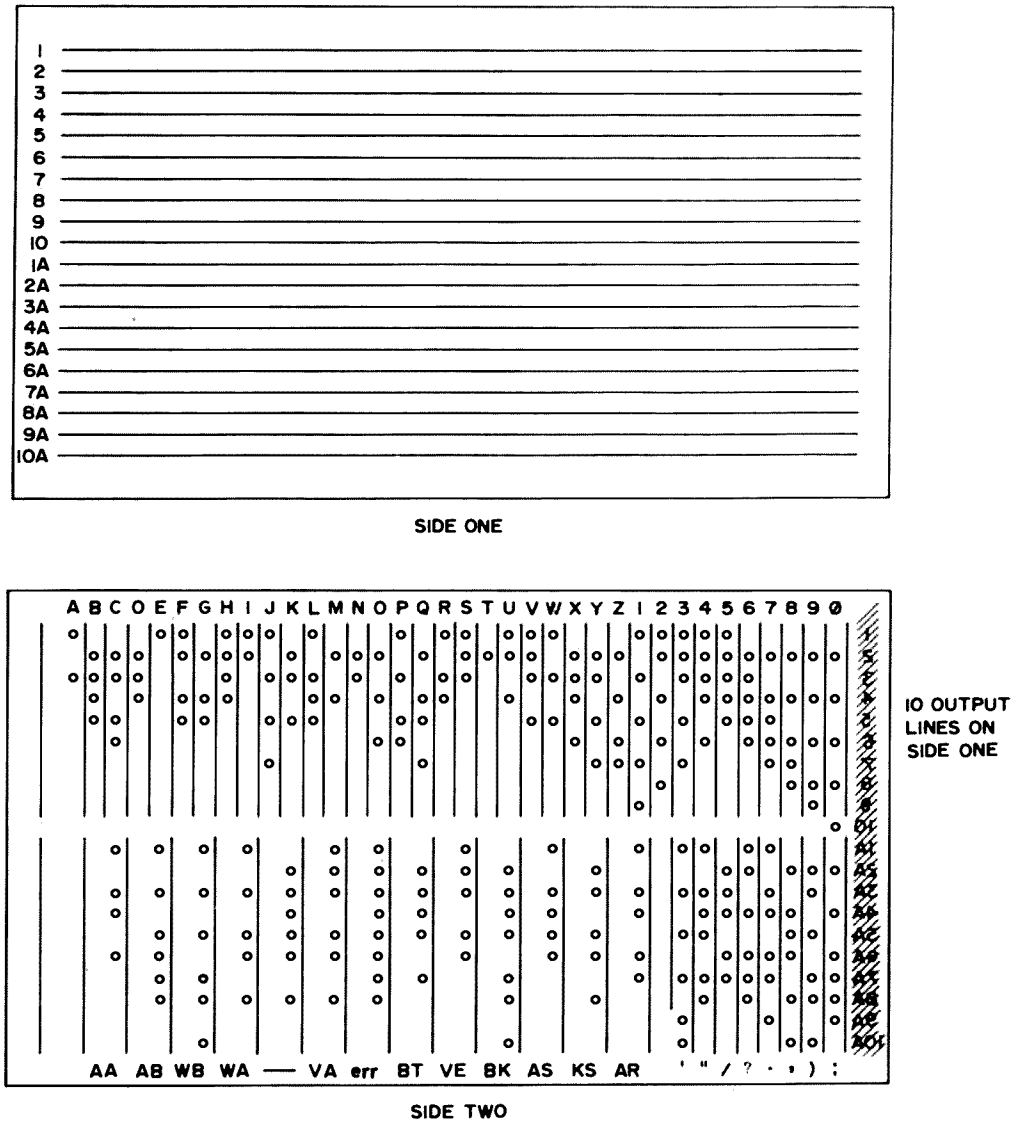


Fig. 9. Diode matrix for button box.

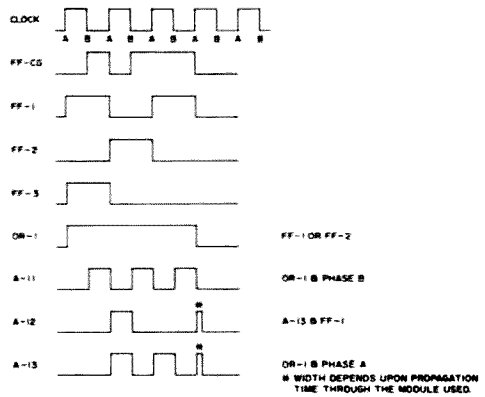


Fig. 11. Timing signals for button-box logic elements.

as there are at least 20 holes across the width and 32 along the length. Hole spacing is determined by the physical size of the diodes you use. Use a heatsink when you solder them to the etched board or the wires on the Vector board, for it is disconcerting to have a bad diode on the first check.

How It Works

Now that we are speaking the same language, and understand the basic building blocks used in this keyboard, or for that matter in any other digital device, let's see what sequence of events must occur in generating CW characters. Examine the simplified logic diagram shown in Fig. 10, and follow the sequence of events on the timing diagram, Fig. 11, for the generation of the letter A in Morse code.When the button of the keyboard is pressed corresponding to the letter A, the encoder output will cause a 1 level to be seen at the "b" inputs to *and* gates A-1 and A-3. For these inputs to appear at the output of the *and* gates, two other conditions (a and c) must be met. Input "a" will be at the 1 level only when all of the flip-flops which comprise the shift-register have been reset to the Ø state. This causes a Ø output from OR-1, which is inverted in 1-2, and places a 1 level on the "a" input to *and* gates A-1 through A-10. With the "b" and "a" inputs enabled on gates A-1 and A-3, but only the "a" input enabled to all others, the appearance of a clock phase "A" to all the "c" inputs will allow gates A-1 and A-3 to set

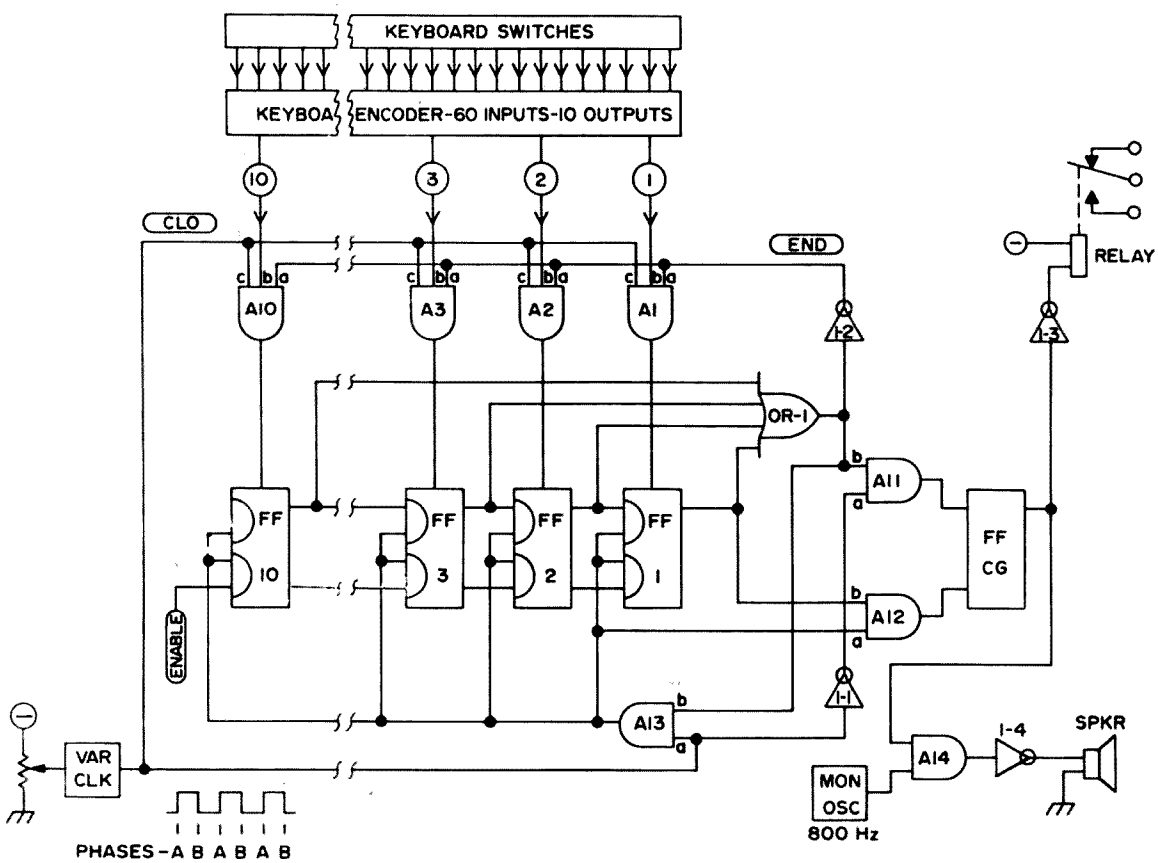


Fig. 10. Logic scheme of keyboard encoder.

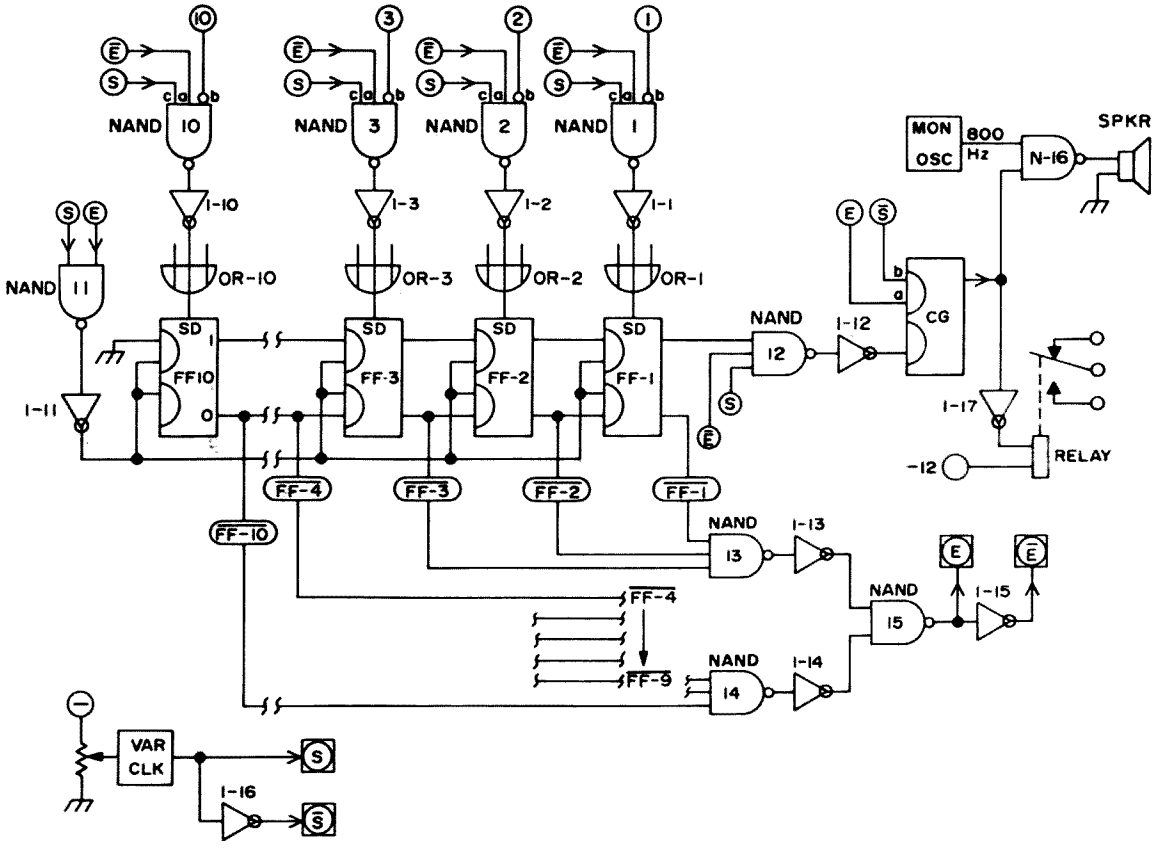


Fig. 12. Nand *logic equivalents for button-box inputs and shift register.*

flip-flops FF-1 and FF-3 to the "1" state. As soon as FF-1 and FF-3 are set, the "1" output of OR-1 causes 1-2 to place a "Ø" level on "a" inputs to the *and* gates A-1 through A-10, thus inhibiting further input from the keyboard until we have completed transmitting the letter "A" that we just placed into storage.

We now have a 1 stored in FF-1 and FF-3, input "b" of A-11 and input "b" of A-13 enabled by the 1 output of OR-1. The first clock phase "A" leading edge allowed the register to be set, but did not get through A-13, since the "b" input was not enabled at the time clock phase "A" arrived, so no shift occurs. Clock phase "B" leading edge now arrives at 1-1, is inverted and is applied to "a" of A-11 which is already enabled by the "b" input. The output of A-11 triggers FF-CG to the set state, keying the output 1-3 and the monitor A-14, allowing the monitor oscillator to be amplified by 1-4. The inverter amplifier 1-3 is shown as a relay driver, but could as easily be the transistor keying unit of a transmitter.

Meanwhile, back in the keyer logic, we now have FF-CG set, a 1 stored in FF-1 and FF-3, OR-1 is still enabling A-11 and A-13 on the "b" inputs, A-1 through A-10 are inhibited by the action of 1-2, and all is in the proper condition for the arrival of the next clock phase "A".

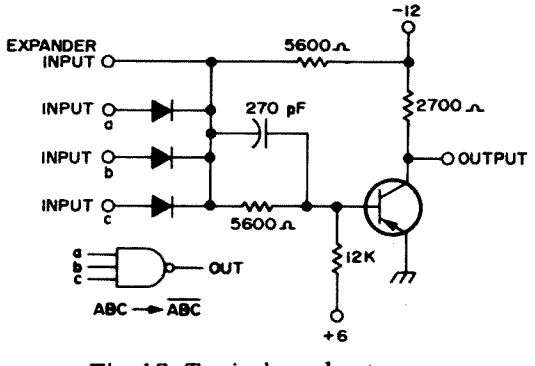


Fig. 13. Typical nand *gate.*

When clock phase "A" goes to the "1" state, here is what happens: A-11 is inhibited by 1-1 and goes to Ø thus closing the set side of FF-CG. The leading edge of clock phase "A" also affects A-13, input "a", and is passed through to the trigger inputs

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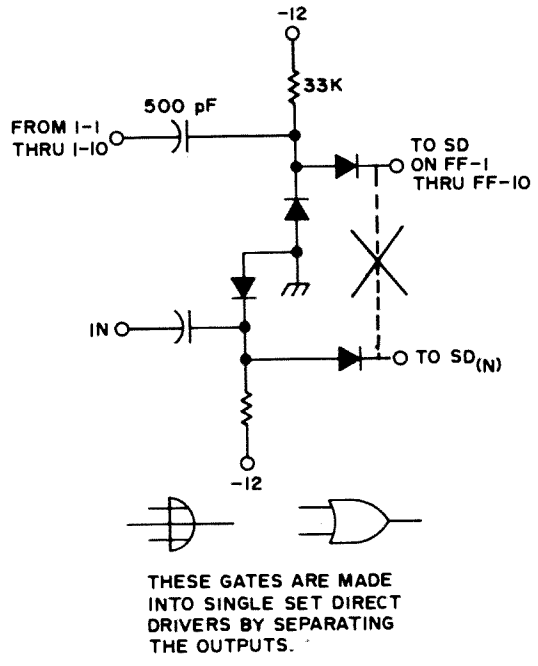


Fig. 14. Typical or *gate. These gates are made into single set-direct drivers by separating the outputs.*

of FF-1 through FF-10, and to the "a" input of A-12 on the reset side of FF-CG. Input "b" of A-12 is enabled by the "1" standing on the output of FF-1, and the output of A-12 causes FF-CG to reset, or go to a "Ø" state at the output, completing the first dot, and releasing both the monitor and keying unit.

At the same time that FF-CG is reset, all information stored in FF-1 through FF-10 is shifted toward FF-CG one position. FF-1 is now in the "Ø" state, FF-2 assumes the "1" state from FF-3, and FF-3 through FF-10 are now in the "Ø" state. Notice that the reset gate of FF-10 is enabled. This is

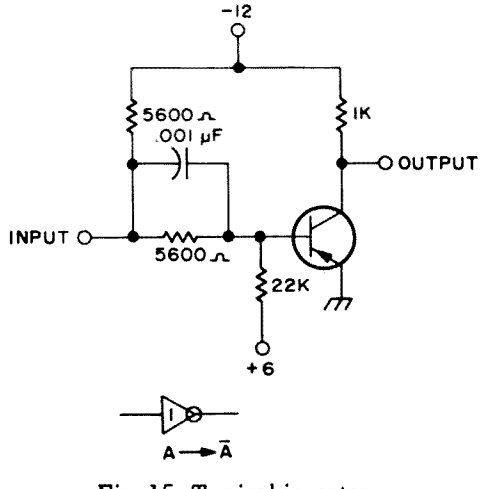


Fig. 15. Typical inverter.

to assure that the shift register will fill up with "Ø" as the shift sequence occurs, and will tell us when a character is complete.

Output levels will now be in the following states: A-1 through A-10 at Ø; A-11 at Ø; A-12 and A-13 at 1; FF-1 at Ø; FF-2 at 1; FF-3 through FF-10 at Ø; FF-CG at Ø; A-14 at Ø; and 1-3 open (unkeyed). These conditions remain until the arrival of clock phase "B".

Clock phase "B" follows the same sequence as before; that is, it inhibits A-13, enables A-11 and sets FF-CG to a 1. Generation of the dash has now started, and nothing else occurs until arrival of the next clock phase "A". Let's see how the dash is made the proper length.

When clock phase "A" arrives, 1-1 inhibits A-11. At the same time, A-13 is enabled and triggers FF-1 through FF-10, and tries to reset FF-CG through gate A-12. But now FF-1 is in the Ø state and is inhibiting the "b" input of A-12, so that

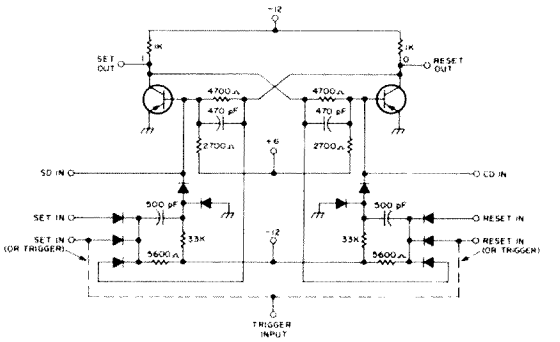


Fig. 16. Typical flip-flop.

the clock phase "A" does not reset the FF-CG. The output remains keyed and we have generated the first one-third of the dash, and at the arrival of the next clock phase "B" will have generated the second one-third of the dash. All that clock phase "B" can do upon arrival is enable A-11 and inhibit A-13. Nothing else will be affected because FF-CG is already in the 1 state, and removal of the 1 level from the trigger inputs to FF-1 through FF-10 causes no action. The output is still keyed, and two-thirds of a dash has been generated, and nothing will change until the arrival of the next clock phase "A".

When clock phase "A" arrives, 1-1 will inhibit A-11, A-13 will be enabled, placing a 1 on the "a" input to A-12. A-13 will trigger FF-1 through FF-10, and the 1 that

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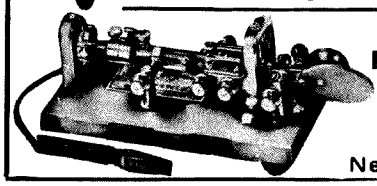
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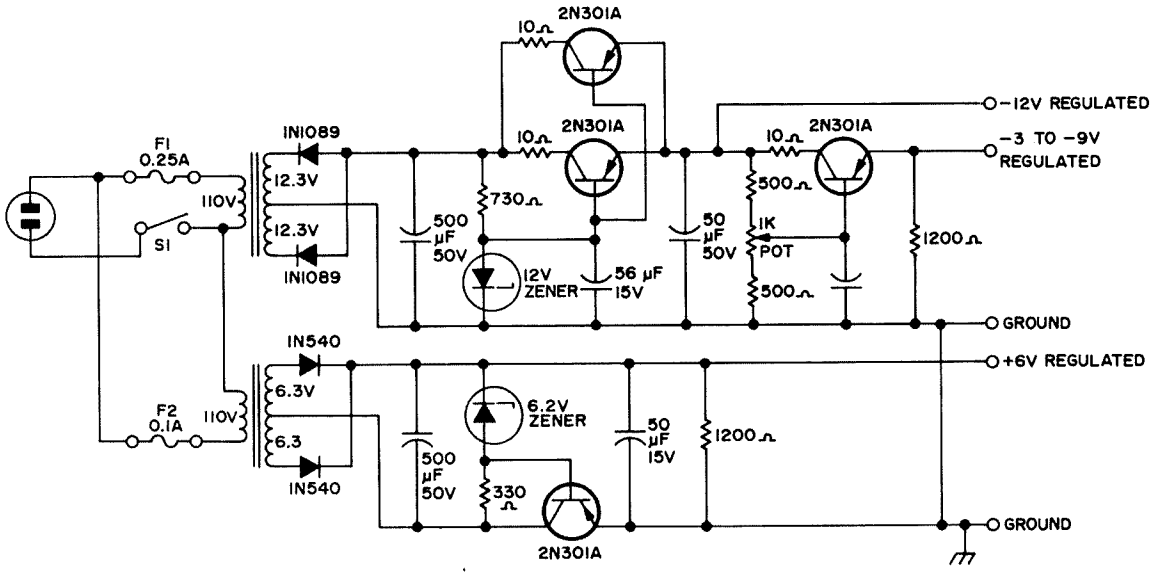


Fig. 17. Regulated power supply.

was stored in FF-1 will be seen at the "b" input of A-12, causing a 1 on the output to reset FF-CG. When FF-CG resets, the monitor gate A-14 is inhibited and 1-3, the drive for the relay is removed, thus opening the keyed output. One dash, three times the length of one dot, has now been generated, but we are not yet complete, even though we have ended the transmission of the dash. What happens now?

If you will think back to the start of this sequence, we allowed the shift register to accept an input at clock phase "A", but did not actually begin transmitting until we set FF-CG at clock phase "B". This delay is part of the space required between characters. The length of a space is the same as a dash, and we have already generated one-third of the space at the beginning of each character, so let's complete the sequence and see how we generate the other two-thirds of the required spacing.

Now, look closely at the logic diagram and examine the conditions awaiting the arrival of clock phase "B". Gate A-11 is inhibited because OR-1 is now at the $\emptyset$ level, since all the 1 levels stored in the register have been used and shifted out. OR-1 does not allow clock phase "B" to set FF-CG. The only tricky part of this arrangement is the loop propagation time through A-13, FF-1, OR-1, and with the clock speeds used here (4–100 pps) any propagation delay up to approximately 100 μsec is all right.

Since the arrival of clock phase "B" had no effect on the output (still unkeyed), the next clock phase "A" may or may not start the generation of another character, depending upon the input encoder. If any button on the keyboard is pressed (including still holding down the letter "A" button) generation of another character will start at clock phase "A". If a button is not pressed, no output will occur until we once more have a coincidence between the encoder output (button pushed) and clock phase "A".

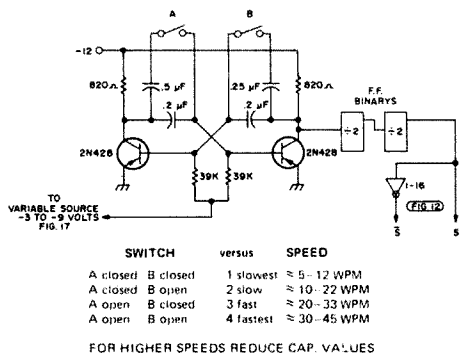


Fig. 18. Variable clock.

In summary, the following is the sequence of events in generating a character: A button is pushed, encoding a character; phase "A" transfers the character into the shift register (memory) and generates one-third of a letter space; phase "B" sets the code generator; phase "A" resets the code generator, dependent upon the state of FF-1, and shifts the stored word one place

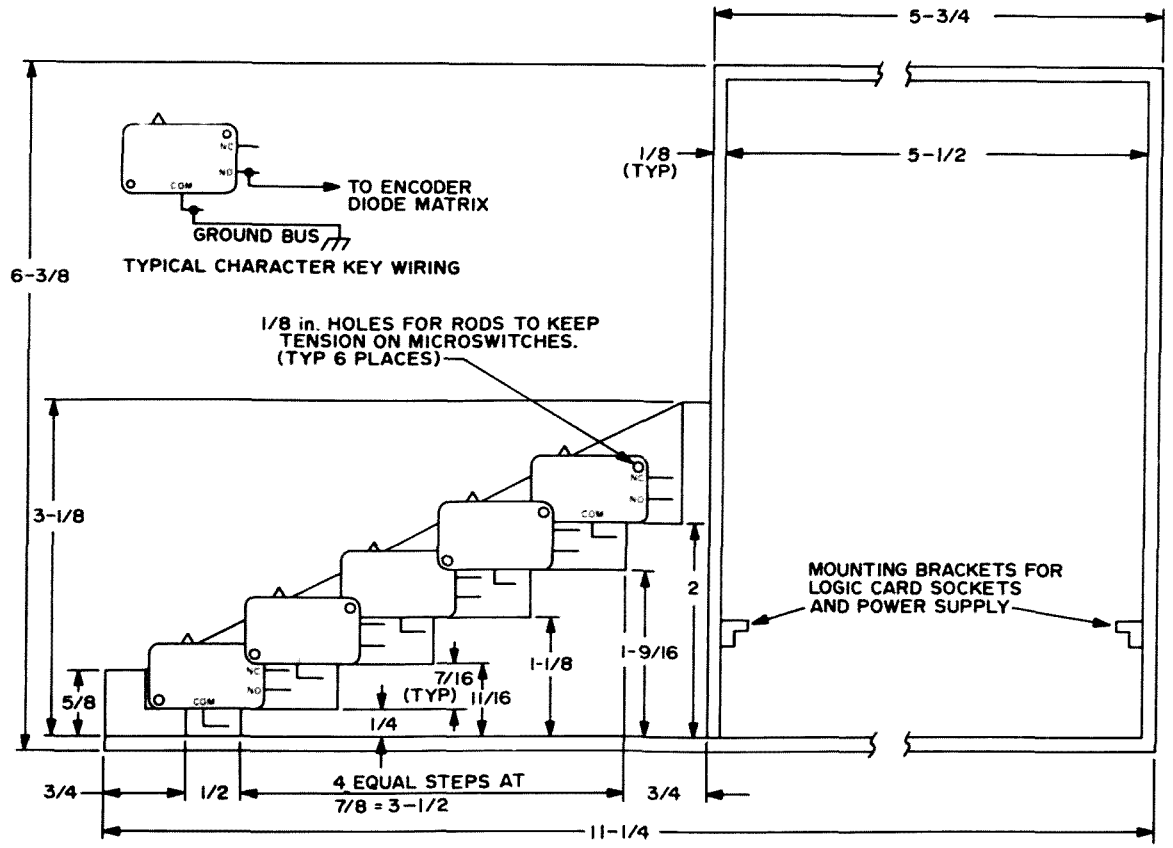


Fig. 20. Side view of button box, with dimensions.

(bit); upon emptying the register, OR-1 and phase "B" generate two-thirds of a letter space.

While the description does get rather involved, it is far simpler to make the button box work than to describe what goes on inside.

Gate Reduction

With possibly some decrease in reliability, gate OR-1 could be reduced to a two-input gate. I don't recommend doing it, but in case someone wants to reduce the number of gate inputs, here is the reasoning for doing so.

Since either FF-1 or FF-2 are set during the generation of any character, it is only necessary to examine the state of these two flip-flops to determine either that the shift register is clear or that a character is being transmitted. As long as either FF-1 or FF-2 is set to a 1 state, the keyboard input gates are inhibited, and the shift gates are enabled. When both FF-1 and FF-2 are in the $\emptyset$ state, further clock pulses are inhibited from setting the code generator or shifting the register, but the keyboard transfer gates are enabled for input of another character from the keyboard.

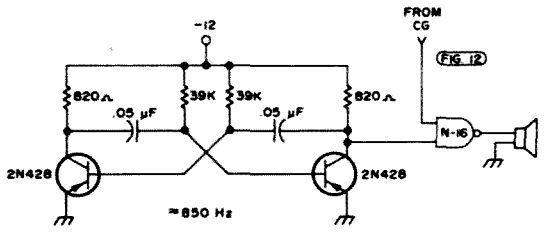


Fig. 19. Monitor oscillator.

Further Notes

Logic cards available at surplus outlets, as well as most of the integrated circuits being sold at bargain prices seem to contain *nand* gates as the standard. Figure 12 shows the implementation of the button box using *nand* logic.

Schematics of typical circuits (i.e., the ones I used) are shown in Figs. 13–19. Let me repeat – there is nothing sacred about these, so if you have some different circuits, and the logic levels are compatible,

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don't hesitate to substitute. If you use ICs, stay with DTL or RTL, whichever you start with, right on through, for they don't work too well when you mix them up.

The oscillator and divider I used for speed control is a bit unusual, but I had the cards and it was simply a matter of expediency that I used them rather than devise another type – such as unijunction – to use for a clock. The same goes for the monitor oscillator (Fig. 19).

If you decide to use "micro" switches – as opposed to building or buying the keyboard – the dimensions shown in Figs. 20 and 21 should be helpful. I used eighth-inch drill rod threaded for 6-32 nuts on both ends to fasten the rows of switches together, with spacers required only on the top and bottom rods for switch separation.

The dowels can be turned on a lathe if one is available, but the turning is not necessary if large enough holes are drilled in the top plate.

By using plywood, the only tools required are generally available to anyone. A handsaw, a rasp, a screwdriver, a drill, a few tears shed after finding a board still too short after already sawing it off twice, and some glue are all you need to fasten the button box together. Your own ingenuity will tell you how to make plug-in sockets for your cards.

Be sure you leave some extra space for additional cards and switches, because you will probably want to make another encoder board for Teletype transmission, controls for the station, a timer, or some other goody. One thing I do not recommend adding – and that is an additional memory. I find that staying right with – or

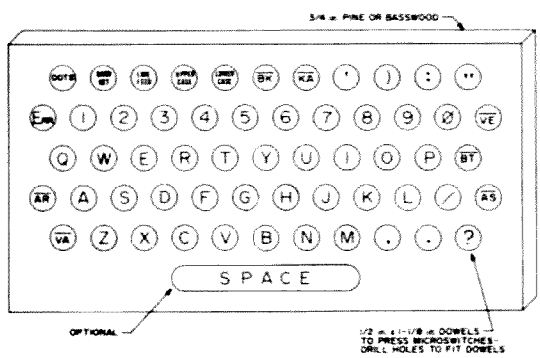


Fig. 21. Keyboard layout.

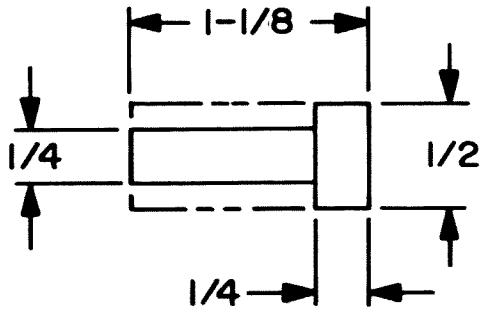


Fig. 21a. Detailed view of button.

half a letter ahead of the letter being transmitted is not difficult, but trying to type something, and listen two or so letters behind the letter you are typing is directly opposite the method used to copy code. To say the least, it is very disconcerting. But additional memory can be added without much problem.

Build one of these button boxes, practice a few minutes to get the hang of it, and hit the airways prepared to enjoy a brand of CW that is more enjoyable than any you have encountered before. Oh yes, you should buy a bigger hat before you start using it on the air, because you are sure to get a swelled head for all the compliments on your fine fist.

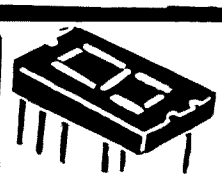
. . .W5VFZ■

Bibliography:
1. Millman, J. & Taub, H.: "Pulse, Digital and Switching Waveforms," McGraw-Hill Book Company, New York, 1965.
2. Phister, M., Jr.: "Logical Design of Digital Computers," John Wiley & Sons, Inc., New York, 1958.
3. Caldwell, S. H.: "Siwtching Circuits and Logical Design," John Wiley & Sons, Inc., New York, 1958.
4. Maley, G. A., and J. Earle: "The Logic Design of Transistor Digital Computers," Prentice-Hall, Inc., Englewood Cliffs, N.J., 1958.
5. Riddle, R. L. & M. P. Ristenbatt: "Transistor Physics and Circuits," Prentice-Hall, Inc., Englewood Cliffs, N.J., 1958.
6. I.T.T. Federal Electric Corporation: "Boolean Algebra — A self-Instructional Programmed Manual," Prentice-Hall, Inc., Englewood Cliffs, N.J., 1966.
7. Delhom, L. A.: "Design and Application of Transistor Switching Circuits," Texas Instruments Electronics Series, McGraw-Hill Book Co., New York, 1968.
8. Packard Bell Computer: "Digital Module Application Manual," Los Angeles, California, 1962.

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JAPAN	14	7A	7B	7B	7	3A	7	7	7	7B	7B	14
MEXICO	14	7A	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	14	7B	7B	7B	7B	7B	7	7	7	7B	7B	7B
PUERTO RICO	7A	7	7	7	7	7	14	21	14A	14A	14A	14
SOUTH AFRICA	7A	7	7	7	7B	7B	14A	21A	21	21	21	14
U. S. S. R.	7	7	3A	3A	7	7B	14	14A	14	7B	7B	7
WEST COAST	14A	14	7	7	7	7	7	14	21	21	21	21

CENTRAL UNITED STATES TO:

ALASKA	14A	14	7	3A	3A	3A	3A	3A	7	14	21	21
ARGENTINA	21	14	7A	7	7	7	7	14A	21	21	21	21
AUSTRALIA	21	14	7A	7B	7B	7	7	7	14	14	14	21
CANAL ZONE	14A	14	7	7	7	7	7	14A	21	21	21	21
ENGLAND	7	7	7	3A	3A	3A	7B	14	21	14	7A	7B
HAWAII	21	14	7A	7	7	7	7	7	7A	21	21A	21
INDIA	7	7A	7B	7B	7B	7B	3B	7	7A	7	7B	7B
JAPAN	14A	14	7B	7B	3A	7	3A	7	7	7B	7B	14
MEXICO	14	7	7	7	7	7	7	7A	14	14A	14A	14
PHILIPPINES	21	14	7B	7B	7B	7B	7	7	7	7	7B	14
PUERTO RICO	14	7	7	7	7B	7B	14	21	21A	21	21	14
SOUTH AFRICA	14	7	7	7	7B	7B	14	21	21A	21	21	14
U. S. S. R.	7	7	3A	3A	7	7B	7B	14	14	7B	7B	7B

WESTERN UNITED STATES TO:

ALASKA	14A	14	7	7	3A	3A	3A	3A	7	14	21	21
ARGENTINA	21	14	7A	7B	7	7	7B	14	21	21	21	21
AUSTRALIA	21A	21A	14	7A	7B	7	7	7	7A	14	14	21
CANAL ZONE	21	14	7A	7	7	7	7	14	21	21	21	21
ENGLAND	7B	7	7	3A	3A	3A	3A	7B	14	14	7A	7B
HAWAII	21A	21	14	7A	7	7	7	7	7A	14A	21A	21
INDIA	7B	14	13	3B	3B	3B	7	7	7	7	7B	7B
JAPAN	21	21	14	7B	3A	7	7	3A	7	7	7B	14A
MEXICO	21	14	7	7	7	7	7	7A	14A	21	21	21
PHILIPPINES	21	21	14	7B	7B	7B	7	7	7	7	7B	14
PUERTO RICO	14A	14	7	7	7	7	13	21	21	21	21	21
SOUTH AFRICA	14	7	7	7	7B	7B	7B	7B	14A	21	21	14
U. S. S. R.	7B	7	3A	3A	3A	7B	7B	7B	7A	7B	7B	7B
EAST COAST	14A	14	7	7	7	7	7	14	21	21	21	21

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

$1.00
March 1972
26009

73 magazine
for radio amateurs



23 • Feature Articles • 23

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ARC-3 (2m), ESM/1, etc.

FM HR-2 Improvements
Nicad Charger

General Class Q & A

73 magazine
for radio amateurs
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73 Magazine is published monthly by 73 Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas, $7 per year elsewhere. Two years $11 in U.S. and $12 overseas. Three years $15, and $16 overseas. Second class postage paid at Peterborough, N.H. and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A. *Entire contents copyright 1972 by 73 Inc., Peterborough NH 03458.* *Phone: 603-924-3873. Subscribers please . . . PLEASE . . . note, there is virtually no way for you to renew your subscription to 73 without receiving at least one extra renewal notice. We've talked with our computer and it is adamant about this. The publisher stands ready to award himself and his wife a free all expenses paid trip around the world, operating from at least 20 rare countries, if anyone can come up with a system which will enable the 73 computer to stop sending renewal notices after a renewal is sent in. A copy of this notice autographed by the publisher will be sent to all readers who complain about getting a renewal notice after they have already renewed.*

Amateur Radio

MARCH MCMLXXII Monthly Ham

HAM DOC HEALS VETS

Reprinted from The Rockland County Journal-News, Nyack, N.Y., Dec. 21, 1971.

By Gale Tollin
Associated Press Writer
Minneapolis, Minn.

(AP) —His friends call him "Doc" but Felton Jenkins is a physicist-engineer and not a physician. He does his healing in the basement of his home, using eight powerful shortwave radios and three telephone lines to deliver therapy to wounded servicemen in Vietnam.

'It's my way of saying thanks to the boys," explains Jenkins.

For the past four years Jenkins has been devoting much of his time and money to putting wounded soliders in voice contact with their families. Six days a week – with Sundays off – he is up at 6 a.m. seated among his microphones, dials and speakers. He handles 25 to 30 contacts each morning, in about three hours, and the number has run as high as 37 when conditions are favorable.

The soldier's conversations with home, Jenkins feels, have medical benefits – especially when nervousness and loneliness figure in the wounded man's condition.

Frequently Jenkins works through the Military Affiliate Radio System – MARS. Ham radio operators in Vietnam patch into a telephone which is taken to the bed of a soldier in a military hospital or on the hospital ships Sanctuary and Repose, anchored off the Vietnam coast.

Jenkins is on the U.S. end of the transmission. He calls the soldier's family by telephone and patches the conversation into his radio.

If the father is at work and the mother at home, Jenkins phones each of them on different lines and patches them into a conference call. The result is that the son in Vietnam, father on his job and mother in her home can chat in a three-way conversation.

"It's like a party line." said Jenkins. "It gives me a certain amount of pleasure to be able to do something for somebody else." he said. "I look at life as a great big mirror. You look in it and smile and it smiles back."

His hobby, he said, brings him satisfactions that can't be measured in dollars.

As an example, he recalled the case of an American solider who had lost both legs in Vietnam.

"His spirits were low, and he wasn't cooperating with the doctors." Jenkins said. "The doctors were about ready to give up on this boy, and they asked me if I couldn't arrange for him to talk with his parents.

"The parents happened to live in Mexico and it wasn't the easiest thing in the world to get them to a telephone. I had a friend in Mexico pick them up and bring them to his radio. We patched them through to their son.."

A business executive friend of Jenkins heard the conversation in Texas on his own ham radio. He broke into the conversation and asked to talk to the boy. He told him he would give him a job. Jenkins and the Texan asked another friend, who heads a string of business schools to forego tuition for the soldier and the third man agreed. The amputee was flown from Vietnam, entered the school, was graduated and went to work in a business owned by the Texan.

"He turned out to be one of the finest employees this firm has ever had." Jenkins added.

Doc Jenkins leaned back in his swivel chair, amid his radio equipment, and summed up his feelings: "You see, some of our work does have its dividends."

Boy Scouts in Radio AWARD OFFERED

Explorer Post 160 of Fairmont MN is sponsoring the Friends of Scouting award. The purpose of this award is to promote the exchange of ideas, memories, planning of future Scouting events, develop interest in the Scouts, and so on. To obtain the certificate, you must work any 25 current members in the Scouts in any country where they may be registered. Exchange QSL and GCR list (i.e., Scouting position such as Cub, Boy Scout, Explorer, Committeeman, Scoutmaster, etc.). Send these with a dollar to Explorer Post 160, c/o Twin Valley Council, Box 22, Mankato MN 56001. SWLs are also eligible for the award.

Other Scouting awards that are available from the Boys' Life Radio Club (Certificate Department, B.S.A., North Brunswick NJ 08903) are the Worked Every Region–B.S.A. This is for submission of QSLs verifying contacts with members of the Scouts in the twelve Scouting Regions. The WAS-BSA is for working Scouters in the fifty states. Only SWLs may earn the Call Area Specialist certificate for verifying stations in all 10 U.S. call areas; and the World Listener award is issued for submitting cards from 25 different countries, at least one from each of the six continents.

NEW MOBILE XCVR



Linear Systems announced recently that it would be entering the two meter FM field with its new SBE model SB-144. The new transceiver is ideally suited for the mobile installation. It has twelve channel capability, ten watts power output, back-lit channel selector dial, and combination S-RF meter. Comes complete with mike, three sets of popular crystals, and mobile mounting bracket. Write to *Linear Systems, 220 Airport Blvd., Watsonville CA 95076.*

News Pages



L to R: Mr. S. E. Fellerman K3FEC, of Kensington, Maryland; Dr. Robert R. Rodman WB4JAW, of Springfield, Virginia; Mrs. Terri Simons; XYL of the late Bert Simons; K4YLP; and Mr. Wilmer G. Rogers WA4OPW, of Ashland, Virginia.

FIRST K4YLP MEMORIAL AWARD PRESENTED

At a recent meeting of the Virginia Amateur Radio Association in Richmond, Virginia, the first K4YLP Memorial Award was presented to Wilmer G. Rogers WA4OPW by Mrs. Terri Simons, XYL of the late Bert Simons K4YLP. Wilmer, an avid DXer, was selected on the basis of the kindness, consideration and courtesy shown in the field of amateur radio.

W.G., as some of his friends call him, is a past president of V.A.R.A. He has given his time unselfishly training prospective hams, helping fellow hams with antenna problems, organizing club activities such as field days and picnics, running phone patches and many other things contributing to the hobby and the Association.

This award was made possible by the Lox & Bagels Radio Club, an organization of amateur radio operators spanning the east coast. The award, an impressive certificate and a $25 savings bond, will be awarded yearly to the member of the Virginia Amateur Radio Association who most displays the qualifications exemplary of those traits displayed by the late Bert Simons.

IN PUEBLO COLORADO

REPORT ON HUNTOON TALK

John Huntoon, ARRL General Manager, recently spoke before the Pueblo (CO) Ham Club. He commented on League activities and policies, and made some interesting comments about the 200 MHz band. After saying that the CBers stand a 50-50 chance of getting part of the band, he went on to say that the League has not filed against the proposal and that the FCC has not definitely recommended it; "If it comes to be, it will hurt, but won't hurt much since the advent of two meter FM . . . If you object, please write your League and it [220] most likely could be the next repeater band."

Following is a reprint of one man's opinion of Huntoon's presentation, *courtesy of The Grid Leak*:

After Huntoon's lecture he opened the floor for questions and discussion and our local hams in my opinion really put Huntoon through the good old fashioned ringer. Some of the questions asked were as follows: Why QST didn't carry more articles pertaining to the subject of FM and FM repeaters? Why didn't ARRL print manuals concerning the FM mode of transmission and repeaters? Why is QST so difficult to read and understand? Why is the FCC calling in at this time Technician and General conditionals for re-examination? What are the chances of the CBers getting the 220 band?

Mr Huntoon stated that in the future there will be more articles concerning FM and FM repeaters. There is an ARRL manual on FM in the process of being prepared and should be ready either in the latter part of 1972 or the early part of 1973. QST will be more readable in the future. Last year he felt the chances of the CBers getting the 220 band were 10 to 1 against their getting it, but as of today he felt that they stood a better than 50-50 chance of getting this band.

His answer to the questions about the Techs and Conditionals kind of gave me a sour taste in my mouth and left me with the feeling that the ARRL as an organization is rather inept and really isn't in too much of a hurry to see the amateur ranks grow. He stated that in his opnion many conditional licenses were obtained fraudulently and if a ham is really interested in ham radio recall by the FCC should hold no fear for the operator. At this point if it hadn't been for Chuck Chambers KØYFR holding me, I might have fallen either to or through the floor.

Most of the hams at the meeting disagreed with the above mentioned answer for a number of reasons. I for one disagree with his answer and the FCC actions for the following reasons: The average Tech conditional because of the bands allotted to him has very little opportunity to use CW. The average General conditional usually uses phone as is the practice amongst most hams. And besides when an individual gets into ham radio and starts operating he usually forgets all the fine points of theory he learned when he was studying for his examination.

Most licensed professions that I am acquainted with never require their licensees to ever have to take another exam to prove their proficiency, even if the individual has been licensed under a "grandfather clause." Now I realize that ham radio is not a profession, but it is a licensed hobby and consequently I feel that the law as it applies to licensing anything should apply. And the law on that point is that it is illegal and a clear example of double jeopardy when an individual has to be subjected either to trial for the same offense or to examination in a profession or hobby for which he already has been issued a license.

In private conversation with Mr. Huntoon, I told him I felt that the ARRL doesn't seem to go too far out of its way battling for hams when various legal situations arise. He told me that to a great extent I was correct because the ARRL lacks funds to get involved in legal and other situations that may arise all over the country.

Unions defend their union members.

Professional associations defend their members.

Why shouldn't ARRL defend its ham members?

Dr. Morris Levinson WBØBSV

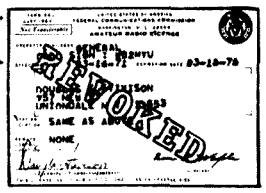
At Long Beach

YL'S TO MEET

Women amateur radio operators will gather at Long Beach, California during the long holiday weekend of May 26–28, 1972. The Sixth International YLRL Convention marks the 33rd year of this organization's activities. As 33 has become the traditional sign-off for QSO's between YL's, the 33rd birthday celebration is a high point in the history of this organization of women amateurs from all over the world, now numbering close to a thousand members. The convention will have headquarters, operating station, meetings, entertainment, birthday luncheon and "cruise" banquet at the Edgewater Hyatt House on Pacific Coast Highway overlooking the Long Beach Marina.

The YL's will entertain their OM's with a tour of the Swan Electronics plant in Oceanside on Saturday, May 27th, returning to the Edgewater for a luau. A visit to the Queen Mary and other harbor points of interest is planned. But the event these YL's anticipate with the greatest interest is meeting in "eyelash QSO's" the YL's they have met on the air or will look for on the air once they return to their home QTH and with whom they share their exciting hobby in friendship, public service and ever-expanding horizons. Los Angeles YL's hosting this convention encourage all who attend to come supplied with a pocket full of snapshots for "swaps" to exchange with calls and autographs. They look forward to seeing Darleen Souligny WA6FSC, who spent much of 1971 traveling and meeting DXers around the world. This year's YLRL President who will preside at the convention is Mae Hipp K7QGO of Sparks, Nevada.

WITH THE FCC



There have been some questions about FM deviation used on six and ten meters. The following reply to a letter of inquiry by W6YAN clarifies the issue:

Section 97.65(c) of the Commission's rules require that F3 emissions used between 50.1–52.5 MHz occupy the same bandwidth as a A3 signal or 6 kHz. Part 2 of the Commission's rules (§2.202) defines bandwidth of an F3 signal as equal to two times the maximum modulation frequency plus two times the quantity one half the difference between the maximum and minimum values of the instantaneous frequency. (B_n = 2M + 2D). As you can caluculate, if the audio modulation is 3 kHz, D must be zero.

FCC-Amateur Rules Section

* * *

A. Prose Walker, chief of the Amateur and CB Division of the FCC, has indicated FCC thoughts about these services. In an interview with *CB Magazine* (January, 1972) Mr. Walker answered several questions that are foremost on the minds of many hams. As far as a license without a code test, there is a possibility that such a provision will be made. When asked about this, he stated, "The International Radio Regulations of the ITU to which the United States is a signatory, contains various provisions relating to the operation of radio stations. Article 41, paragraph 3 (1) states that Administrations may waive the requirement for capability in Morse code in the case of amateur stations making use exclusively of frequencies above 144 MHz. For years we have been told that one of the reasons why more licensees in Citizens Radio do not progress to Amateur Radio is because of the requirement for the code. Even though the code requirement for the Novice and Technician license is only 5 words per minute, indications are that it is still a hindrance. We believe that 5 words per

HOT GEAR

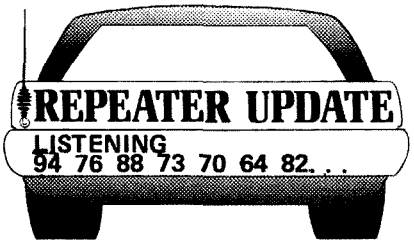
HR2A, S/N 04-6208, stolen from car in New Orleans LA. E. A. Shaw, P.O. Box 1346, Pascagoula MS 39567. W5FXX/5.

Heath SB102, S/N 132-128107, Warren Singer, 13721 Lynn St., Apt. 8, Woodbridge VA 22191 (703-491-2257).

List from Past Issues:

Mfr., Model, Ser. No.	Owner	Issue
Halli., SR46A, #446100	WA1EMU	9/71
Reg., HR-2, #04-03505	WA5BNM	11/71
Sonar, FM3601, #1003	WB2ARM	11/71
Coll., 75A4, #804	WØMGI	12/71
GE, Portable, #1041218	K2AOQ	1/72
Coll., 75SE-B, #15640	Col.St.U.	1/72
Coll., 21S3, #12000	Col.St.U.	1/72
Coll., 516F2, #1649	Col.St.U.	1/72
Simp. Mod-A, #35457	W2PWG	1/72
SBE SB-33 #103906.	WA5JGU	2/72
Heath HW22A #907-18375	W1BDX	2/72
National HR050 #280019	WA5DQF	2/72
Hallicrafters SR160 #416000-108039	K9YVA	2/72
Drake TR3 #3858	WA9EYL	2/72
Collins KWM2A #13815	ARRL HQ M. Godwin	2/72
Collins 312B4 #59920		
Col 30L1 #40084		
Col MPI #44507		
Col MM1 (mob. mike)		
Misco minispkr.	Sgt.Hopkins Wilm. DE Police	2/72
Swan SW174 #426-5	WØAXT	2/72
Reg. HR2A #04-05896	K4GBL	2/72

PLEASE INCLUDE YOUR ZIP CODE WHEN YOU WRITE 73.



CO	KØPHF	Pueblo	28–88
FL	WB4QEL	Orlando	16,34–76
IL	W9MJL	Danville	22–82
MD	K3BEQ is now WA3KWG		
OR	W7DXX	Mt. Scott	34–94
		T2.5 52.525	
		T2.88 29.68	

CANADA
Ontario

VE3KCR	Chatham	34–94
	(projected	37–76)
VE3KER	Kingston	34–706
VE3LAC	London	46–706

Thanks to W4FZX, WB9FOP, VE3CSK, VE3RL.

Amateur Radio, August 1971. New Zealand has been working on a 2 meter band plan for the country. In the draft plan we received, they have made provision for all modes of operation. There are FM simplex channels every 50 kHz from 145.8 to 146.2 MHz, with 145.85, 146.0 and 146.15 MHz, as the prime channels. 146.0 MHz to be first. On the FM repeater side they have allocated four channels on 700 kHz spacing. A pity, as it does not make them compatible to Australia. Inputs on 146.3, .35, .4 and .45 with the outputs on 145.6, .65, .7 and .75. The three-channel AM repeater systems have inputs on 144.6, .65 and .7 with the outputs on 145.725, .775 and .825. 144.8 MHz, is set aside as an RTTY net frequency. The beacons are on the "hundred" equal to the call area, e.g. ZL1 on 145.1, ZL2 on 145.2, ZL3 on 145.3, and ZL4 on 145.4 MHz. The segment 144.0 to 144.1 MHz is set aside as DX and experimental working. 144.1 to 144.5 MHz is a general working segment.

Federal Repeater Secretariat.

minute is a bare minimum, and is not difficult to achieve with proper application of effort. Nevertheless, we are actively considering amending portions of Part 97 of the Rules and Regulations for the Amateur Service which would permit operation above 144 MHz without the code requirement included in the examination. In all likelihood, there will be two classes of no-code license. One will be roughly equivalent to the General Class but for VHF and UHF operation; and the other equivalent to the Advanced or Extra Class covering only above 144 MHz. The examination will be completely new and will cover VHF and UHF related technical matters. Another aspect we are also considering is to possibly require the licensee of an Amateur Repeater station to hold the higher class of license."

The EIA proposal that would eliminate several megahertz of the amateur 220 MHz band and change them into a Class D Citizens Band was another topic for discussion. Mr. Walker had this to say about RM-1747: "We have given it considerable attention over the past months since it was filed with the Commission. The decision has not yet been taken whether to issue a Notice of Proposed Rule Making. There are various factors involved such as the priority of use of the 220 MHz area of the spectrum; the possibilities of other needed uses if a change in the existing allocation were to be considered; what would happen to 27 MHz if the band for CB were changed; whether the same type of operation as now exists on 27 MHz would also prevail on 220 MHz and what would be the ramifications of that; whether the CB user actually wants or needs such a drastic change in the spectrum allocation for the Service or whether the proposed plan is primarily for the benefit of the manufacturer in opening up a new market. Details of all these and other considerations would take up a great deal of time. Let me assure you again that we are giving most serious consideration to RM-1747, but we are not on the verge of a decision as to exactly what is the best course to follow. You know that we are charged with the administration of the CB Service and therefore we must give full consideration to the maximum benefits to be derived by the licensees from whatever course is followed. Obviously, no one would desire opening up a new area of the spectrum without the assurance that the operation to be expected would be an improvement over that now obtained on 27 MHz. You also know that the band 220–225 MHz is currently allocated to the Amateur Service on a second priority basis to Government. No doubt the Amateurs would like to be heard whenever the moment is propitious, such as the possible issuance of a Notice of Proposed Rule Making. I repeat, we have not yet reached a conclusion as to the manner in which we shall dispose of RM-1747."

As for the current abuses of the Citizens Band on 27 MHz, Mr. Walker mentioned that working skip is not the main problem; "Actually, there are many others of a more serious nature which have nothing whatsoever to do with long distance transmission; failure to identify, use of pseudonyms in lieu of call signs, foul and obscene language, threats of bodily harm to others, use of high-power linear amplifiers, operation on frequencies not allocated to the Service, intentional interference, and many others which reduce the potential usefulness of the Service for those who wish to use it for the purposes intended." He mentioned that these violations are being taken into consideration. He further indicated that a very large amount of self-regulation must prevail if the Citizens Service is to perform its intended function. "One of the most useful procedures would be to emulate the degree of self-regulation that has prevailed in the Amateur Service for the past 50 years."

■BULLETIN■

HAM INJURED IN ATTACK BY 'QST'

by WA1NQJ (Special from The Squelch Tale)

K1RGQ was viciously attacked by QST Magazine recently. However, showing true heroism and amateur spirit, he rescued his Swan and Regency, sustaining an injury to his arm in the fray. John assured us that he is now fully recuperated.

While tuning in on K1FFK – 6 meters – and eagerly peaking his wattmeter, John saw that his homemade bookshelf containing many, many years of back issues of QST Magazine was beginning to topple. If things had fallen in the direction they were headed, all of his gear would have been knocked off his operating table to oblivion. John, anticipating damage to his gear, threw himself over it; the magazines and bookshelf fell, throwing John to the floor and pinning him there. Alone in the house, it took John approximately an hour to extricate himself. He is happy to report that his arm is fine now and that none of his gear was damaged.

SEMICONDUCTOR NEWS

D. Thorpe

RCA says goodbye to germanium and silicon small-signal transistors.

RCA's Solid State Division has decided to phase out over one hundred types of small-signal transistors. Included in the cutback is the whole line of small-signal silicon transistors. The devices discontinued are as follows:
Silicon: 2N2475, 2N3241, 2N3261, 2N3512, 2N3932, 2N3933, 2N4068, 2N4069, 2N4074, 2N4259, 2N4390, 2N5180, 2N5183, 2N5184, 2N5185, 2N5186, 2N5187, 2N5188.
Germanium: 2N388, 2N398, 2N404, 2N1302, 2N1303, 2N1304, 2N1305, 2N1306, 2N1307, 2N1308, 2N1309.
40,000 Series: 40231, 40232, 30233, 40234, 40235, 40236, 40237, 40238, 40239, 40240, 40242, 40243, 40244, 40245, 40246, 40354, 40355, 40397, 40398, 40399, 40400, 40405, 40413, 40458, 40519.

GE Discontinues IC Manufacturing

GE has quit making their popular line of audio IC's such as the PA234, PA237, PA246, PA263. Most of these are already in short supply – for example there are no more PA237 devices to be had. Best bet for audio IC's include the Motorola MFC9020, MC1316P, RCA CA3020, CA3020A and Plessey SL403D.

The RCA devices are already hard to find, for example the popular 2N5188 and many of the 40,000 series are in short supply. In most cases, a suitable replacement device can be used so the situation isn't as bad as it first may appear. If you need help in locating replacement devices for RCA transistors or GE integrated circuits contact *Circuit Specialists Co. Box 3047, Scottsdale AZ 85257.*

SSTV SCENE

Among the notes of special interest this month is the addition of XW8AX to the SSTV ranks. Since Asia has the lowest amount of SSTV activity, I'm sure he will be quite busy handing out those 'Eyeball QSO's and instant QSL's." This, at last, makes worked all continents on SSTV a reality for us all . . . provided you can catch him. Try listening around 1200–1300 GMT Saturdays and Sundays on 14.230 kHz. You SSB DXers take note here . . . you can work anybody in Asia for an Asian QSO. We have to work a specific station and swap not only signal reports, but pictures as well. DXing Supreme, eh?

(continued on page 13)



EDITORIAL BY WAYNE GREEN

GOING THROUGH CHANNELS

One of the biggest features of FM communications is the concept of channelizing. What a difference this makes! One wonders what might happen to low band communications if we could introduce this novel concept there.

With two kHz channels in the 20 meter phone band we could have 75 sideband channels in that 150 kHz wide band. Would we have better communications this way or worse? We might have essentially 75 going roundtables during the more active hours, but the less time that each operator could talk would make it a lot easier for everyone. Or would it develop that we would have 75 channels all sounding like the CB channels? Would we have multi-kilowatts and giant beams blasting through on each of the channels, ignoring the lower powered peasants? It has worked well on two meters, perhaps it might on 20. We could try.

If we were to start with one channel on twenty meters and then gradually expand this to two, three . . . etc., perhaps we could see how we might go with channels. An FM-sideband interface which would permit a two meter repeater to work cross-band to twenty on a national channel could be a starter. Perhaps something like 14,250 kHz? This isn't a bad spot. It is a bit below the SSTV group and above most of the serious DXing. It is below the General Class band and the intensive QRM of the nets and frustrated rag chewers who operate there. Channel two could be 14,248 . . . etc.

Think of the benefits to everyone. It would, first of all, make a lot more fun for the two meter FMer, expanding his horizon to the world. It would bring FM to the attention of the low banders, whetting their interest and perhaps speeding up the swing to FM of more old timers. It would encourage more repeaters to handle the traffic and rag chewing which would develop. And if channelization helps on twenty meters, that would be the best benefit of all!

The legal problems of Techs using 20 meters by proxy have been covered in depth elsewhere.

CONTROL

The key to the question of legality of Techs being repeated out of the Tech bands lies in the matter of control. If the FCC decides that the carrier coming from a Tech station is controlling the transmitter of the repeater, then the Tech would be in control of the output carrier and would be required to be sure it was within a band his license called for.

But is the Tech carrier really in control? Let's look at that situation more carefully. Let's think a little more deeply about the word "control." Our problem here is one of a lack of definition . . . one where Techs might have one definition and the Commission another.

Perhaps we can clear things a bit by drawing a parallel. Let's take the case of an Advanced Class station on 20 meters. Sideband, of course. As normally operated this station used VOX (voice on transmit), a gadget which turns the transmitter on when someone speaks into the mike. When a visitor speaks over this station his voice turns on the transmitter, even though he has no amateur license at all. This is quite legal as long as the licensed amateur is present and is "in control" of the station . . . which means in essence that he can turn off the station if something goes wrong. Control then is the ability to turn a transmitter on or off in an emergency and not the routine turning on and off of the transmitter.

This is exactly the situation we have with repeaters. While the carrier from a Tech does indeed actuate the repeater transmitter, this does not interfere with overall control by the licensee of the repeater. Control of a repeater may be via 450 MHz link, by phone line, or other accepted means, but this is the control and the FCC will have to make sweeping changes in their interpretations of the rules before they can prevent repeaters from relaying Techs into the General parts of the two meter band . . . or even into the Extra parts of 75 meters!

WHAT IS AM?

Those readers who are theory minded may be able to commiserate with me on the problem of amplitude modulation. I've read a lot about it down through the years and felt there must be something basically dense about me since none of the explanations made sense. Why, if we are varying the amplitude of a transmitted carrier, does the carrier not vary in amplitude? And those sidebands, what are they and where did they come from?

Pity a chap named Robinson out in Michigan who has managed to come up with a real amplitude modulated carrier and has found that he has patent problems because everyone, including the Patent Office thought that "amplitude modulation" resulted in the carrier varying in amplitude.

The process that we have always considered as amplitude modulation was actually a high level mixing of audio and radio frequencies, resulting, as always, in mixers, in the sum and difference of the two mixed frequencies plus the two original frequencies.

I don't suppose you really want to be bothered with an attack of theory like that, but the concept hit me and I thought I would pass it along.

NORTHEASTERN REPEATER MEETING

Representatives of several of the repeaters in the New York and New Jersey areas got together in early January to hash out problems of repeater interference and, to the pleasure of all, came to agreements. This is certainly a very welcome step ahead.

The basic agreement was for repeaters to shift to 600 kHz spacing and thus bring about the orderly growth of repeater use on two meters. A full report on the meeting will eventually filter through, but the word is that WA2SUR in New York will shift from 19–73 to 13–73, that WA2UWR in Paramus will change from 28–79 to 19–79, WA2YYQ on Staten Island will go from 25–88 to 28–88, WA1KGK in Trumbull will change from 22–76 to 16–76, WA1KGD in New Haven from 11–61 to 01–61, and so on. It is possible that K1MNS in Derry NH will go from 25–76 to 25–85, but this leaves a question about WA1KFX which was 31–88 and was apparently being set up on 25–85 as soon as power was restored on Mt. Snow . . . it would clobber MNS. WA1JTB in Greenwich is still in doubt too, but may go 31–91.

This rash of agreements will undoubtedly bring about even more with K1FFK expected to shift to 04–64, WA1KGS (Waltham) to 01–61, WA1KHA to 25–85 in Torrington, WA1KGQ to 19–79, etc.

The move toward a national transceive channel got a boost too,

with an agreement to go 146.52 transceive throughout the New York–New Jersey areas. The next step is to encourage manufacturers and distributors to see that all newly sold transceivers come out with this pair in them instead of the old 146.94 pair which has muddied the waters so badly in several major areas such as New York City and Chicago.

* * *

The FM scene changeth fast and it is difficult to try and keep up with events in a monthly magazine.

Saroc came and went in early January. There were more exhibitors and visitors than ever and, despite a lack of planning as far as the speaking program went, everyone had a good time. FM was the watchword, with hand units everywhere and the regular channels filled around the clock, often sounding more like CB than amateur after the frequent cocktail parties.

The Pallisades Amateur Radio Club group turned up in force and brought with them their own instant repeater (right out of the October 73, by the way) so everyone could use their weird Los Angeles crystals while visiting Las Vegas (146.61 in, 147.33 out!). This enabled all of the club members to use their mobile and hand units during their stay without changing them over to the 34–94 Nevada repeater channels.

With the idea of promoting some organization of the FM growth in the northeast, we started the Repeater Bulletin back in January. This publication is being sent free to everyone using the New England repeaters and the reaction to the first 24-page issue was universally enthusiastic. The second issue, a 32-page bulletin, is now out and the publication seems to be achieving its objective of providing a forum for discussion of development of FM in the New England area.

In line with the idea of helping New England repeater groups to coordinate, an FM Symposium was planned for February 12th. Apparently this threw some of the vested interests into panic and a swift behind the scenes effort was made to set up an FM organization which would pull the rug out from under the symposium. Rather than being dismayed at this, I think it is a good move. The objective is to set up a system of self-government and the agreements made so far are quite in line with this. There is still more to be done, obviously, and 73 will do whatever it can to help this along.

To those who are afraid that 73 or Wayne Green are going to try and take "power" away from them, I say that I seek only the power of reason. I do not want to run anything or dictate, but I do want to be heard and I want to help anyone else with ideas to be heard . . . I ask no more than that. Power all too often means running roughshod over people with ideas that differ from yours and it is this power that I dislike.

The symposium should be interesting. It will be reported in the next issue of 73. The first session of the symposium will tackle frequency synthesis and will feature a panel discussion with Ed Clegg and Andre (Vanguard Labs). Gil Boelke may also be present, if the new Bara synthesizer is completed in time.

The second session will tackle needed FCC regulation and this will be reported in full to the FCC. I think we amateurs want to be self-policing and to have a strong say over our own rules. Sessions such as this should help us in this.

The third session will attempt to get the representatives of the New England repeater groups to set up a frequency board which will help new repeaters to find channels and assist present repeater groups in working toward a minimum of interference.

Following the third session will be the banquet with Jean Shepherd K2ORS as the speaker. Jean, one of hamdom's best known writers and humorists, is heard nightly over WOR, WGBH and other stations, has a book on the current best seller list, and has a television series (Jean Shepherd's America) which has been highly acclaimed. Few of us have missed the hilarious stories he has had published in Playboy, which have won him their coveted humor award for several years running.

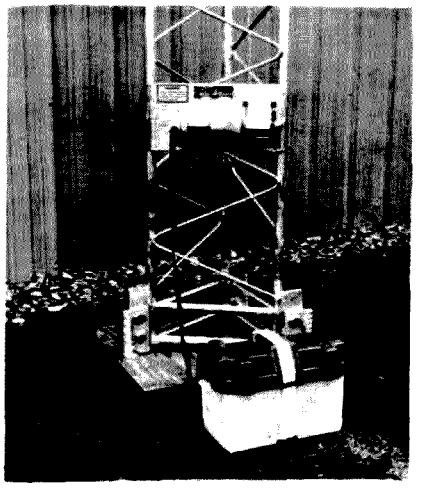
After the banquet there will be one last technical session tackling the pros and cons of changing the current 600 kHz spacing to 1 MHz channel spacing. The arguments are formidable for 1 MHz, so it is entirely possible that the repeater representatives might opt for that on the spot. We shall see next month.

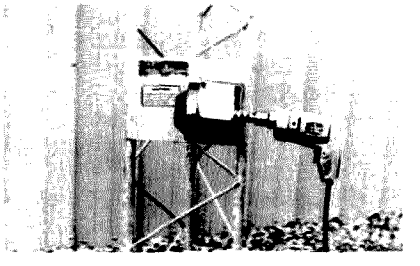
. . . W2NSD

NEW PRODUCTS

NEW WINCHES MODERNIZE TOWERS

Tri-Ex Tower Corporation of Visalia, California, has announced the release of two new electric winches for crank-up towers. The 12 volt electric reversible winch is sold with power cables; the battery in weather tight case and 110V AC battery charger are optional. It has forward and reverse speeds for raising and lowering the tower, and a level wind assembly to keep the cable from stacking. Braking is immediate, without coasting or creeping. The electric winch adds a safety feature in eliminating spinning handles, slipping clutches or exposed gears.





The TDD-100 Winch is driven by the average 3/8 in. drill. Two drive bits are furnished with the winch to be inserted into the gear train for raising and lowering. If the drill is not reversible, the short drive bit can be inserted in the opposite end of the winch to lower the load. Braking is automatic and the TDD-100, stopped at any point, will hold a load indefinitely.

Both winches are easily installed and bolt directly onto the existing tower winch mounting frame. For complete information on the new Electric Winches, write *Tri-Ex Tower Corporation, 7182 Rasmussen Ave., Visalia CA 93277.*

HAND-HELD SSB

If you do not want to go FM, here's a hand unit for the low band enthusiast, single sideband at that. The Mini-Mitter II is a crystal controlled rig that runs four watts PEP output into a fifty to seventy-two ohm load. The beauty of this unit is that a short whip antenna is available as an accessory and the unit is instantly portable for field day, emergency, or camping, or just having fun sitting under the sun in your back yard. The power level is adequate for medium range QSOs when the kilowatts are not on top of you, but that's the fun of QRP opera-

(cont. on page 8.)

More New Products

(continued from page 7)

tion. The Mini-Mitter is available as a kit for $150. Popular frequencies of 3995, 7215, or 7255 are available, and the rig can be changed according to instructions in the manual. For complete information, write to *American States Electronics, 1074 Wentworth St., Mountain View CA 94040.*

MINIATURE BUZZER

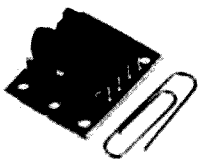
Miniature is the word, too . . . 7/8" long, 5/8" wide, and 3/8" thick is small. The output is good and loud, though, despite its small size to permit it to be used for code practice for a good sized room full of people. The buzzer is available in 1.5 and 12 volt dc models, with the 12-volt unit drawing only 15 mA, quite low enough to be operated by a transistor gate for paging or warning applications. The quarter ounce unit is small and light enough for uses in hand transceivers.

The Model GA-100 buzzer is solid state and has no moving contacts, therefore there is no arcing and no electrical or rf noise generated as with most buzzer units which act as miniature spark transmitters.

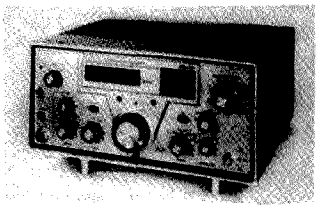
The output tone runs around 400 Hz, about right for code practice or paging uses.

The buzzer is being marketed by *Projects Unlimited, Box 1426 Northridge, Dayton OH 45414,* and sells for $5.95 through parts distributors.

MINIATURE TONE ENCODER



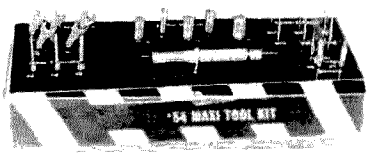
Alpha Electronic Services Inc. has announced its new hybrid tone encoder Model ST-85J which is designed for use in all two-way radio communication equipment including portable and hand held units. This compact, easily installed unit provides an economical method of controlling base stations, repeater stations or special functions. Current requirement is less than 4 mA at 12.6V. Composed of two thick film chips, one containing the encoder circuitry and one containing the frequency determining network, the ST-85J is available with several installation kits and simple step-by-step instructions to assure easy installation in any make or model of radio, especially where space is a premium. For additional information, write *Alpha Electronic Services, Inc., 8431 Monroe Avenue, Stanton CA 90680.*



SSB TRANSCEIVER

You can be top man on any band with Sideband Engineers' SSB transceiver. This rig offers six digit frequency readout on all bands eighty through ten; that's 100 Hz direct reading, and the vfo skirt is calibrated so you can reset your rig to precisely the same frequency time after time. But that's not all. The 500 watt PEP input is sufficient for barefoot operation, and for those who want to run the full legal limit, a two kilowatt linear amplifier will soon be available. The SB-36 has a built in VOX, semi break-in CW, and separate crystal lattice filters for upper and lower sideband. These filters allow the rig to produce clean and crisp SSB audio without frequency shift when changing sidebands. (Ever try to work someone on LSB on forty in the evening? Try USB for a pleasant surprise.) Accessories include an external vfo for split frequency operation and a CW receiving filter to help you pick out the rare ones from the QRM. For more information on this amazing rig, write to *Linear Systems Inc., 220 Airport Boulevard, Watsonville CA 95076.*

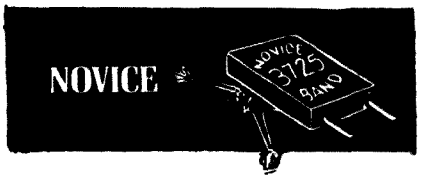
SUBMINIATURE TOOL SET



Tiny multi-purpose instrument tools in a 22-piece set are now available for use on very small fasteners. Suitable for use by instrument repairmen and hobbyists the tools are designed for instrument repair and light assembly work involving very small nuts, set screws, and machine screws.

The tool set, Mini Kit No. 54, contains six jeweler's type screwdrivers, two cross-recessed Phillips-type drivers, five open-end wrenches, three Allen-hex type wrenches, five socket wrenches, a marking scribe, and a knurled, chuck-type handle for positive gripping. The blades are interchangeable, and all are made of hardened, tempered nickel-plated tool steel. The complete set is packaged in a clear plastic box for easy use and convenient storage. It is priced at $14.50, postage paid.

For further information, contact *Jensen Tools and Alloys, 4117 N. 44th St., Phoenix AZ 85018.*



Dear Sirs:

I have been trying to receive DX stations and stations on the West Coast. However, I have not had very much luck. Please tell me the times during which I can work these stations, and the bands where they usually are found. I would appreciate it very much.

Sincerely,
Roger W. Miller WN1OGZ
Bantam CT

Dear Roger,

Well, I guess you have found that it really takes a lot of digging to get the DX. Although I am not as much a DXer as some, let me share some hints I have worked out and a few of those from people more successful than I.

First, listen a lot. There's an old adage that says God gave us one mouth and two ears to be used in that ratio. It's good advice. Very few DX stations will come back to long CQs, and the rare ones usually do not come back to me then I call CQ DX. That is what I have found. Listen a lot in the General portions of the bands to get an idea about what frequencies are most active and open. Use a good receiver with a good antenna; a ten foot long-wire just will not make it for consistently good results. A set of earphones is a good investment, especially if you intend to do any late night listening, and even more important if your shack is in your bedroom.

Second, choose your frequency carefully. Fifteen seems to be going out and forty and eighty are coming in due to the changing sunspot cycle. Now that the sun is sending out less radiation that ionizes our atmosphere, higher frequency signals (e.g., fifteen meters) are not being reflected to distant locations. The last time the sunspots changed around like they are doing now (they work in eleven year cycles), I found that winter months meant forty was *my* best band. A friend of mine consistently worked Russians on eighty. A second friend used to listen intently on ten meters for the freak band opening and he worked Africans. It is only fair to tell you that all of this was in the early morning, around six or seven. Others I know preferred the late, late night, after the TV stations closed down. Their results were similar. By the way, my best direction was South America.

At night, you have probably found that it is extremely hard to pick out another ham on the forty meter band. It seems that foreign broadcast sta-



VERMONT QSO PARTY

All amateurs are invited to participate in the Vermont QSO Party sponsored by the Central Vermont Amateur Radio Club. Vermonters are urged to work as many out-of-state stations as possible so that those interested can earn credit toward WAS, WANE, W-VT and USA-CA Awards.

1. TIME: Saturday, Feb. 26, 2300 GMT (6 P.M. EST) to Monday, Feb. 28, 0300 GMT (10 P.M. Sunday)

2. SCORING:

Vermont stations 1 point per contact and multiply by the number of ARRL sections and foreign countries worked.

Outside stations 3 points per Vermont station worked and multiply total by the number of Vermont counties worked on each band.

QSO credit with the same station on different bands and/or modes will be given.

3. AWARDS:

(A) Certificates will be awarded to the highest scoring stations in each ARRL section.

(B) To the highest scoring station outside of Vermont, a trophy will be awarded.

(C) To the highest scoring station in Vermont, a trophy will be awarded.

(D) To the 2nd, 3rd, and 4th highest scoring stations in Vermont a special certificate will be awarded.

(E) The W-VT (Worked Vermont) Certificate will be awarded to stations working 13 out of Vermont's 14 counties, provided the station has not previously been issued this award.

(F) Special certificate for multi-operator stations.

4. EXCHANGE: Vermont stations send number of QSO, RS(T), and county. Others send QSO number, RS(T) and ARRL section.

5. GENERAL CALL: For non-Vermont stations: "CQ VT" or "CQ VT QSO Party". For Vermont stations "DE VT" or "Vermont Calling".

6. LOGS (or facsimiles): Postmarked *no later than March 31* should be sent to CVARC care Ansel R. Carnahan, P.O. Box 3, Montpelier VT 05602.

7. Stations sending a S.A.S.E. will receive a copy of the results.

Vermont stations are urged to be active and to promptly QSL all stations worked.

* * *

The Fifth Annual OOTC QSO Party will be held from Tuesday, March 14 through Thursday, March 16, starting and ending times both 2300 GMT. Scoring for Canadian and U.S. amateurs is one point per contact per band. Contacts with stations outside of U.S. and Canada count three points per contact per band (KH6 and KL7 count as DX). Foreign stations earn one point per contact per band for QSOs within their own country. Five points are earned for contacts outside of their own country. All modes are allowed, but only one contact per station per band may be scored. Multipliers: Count each state, province, or country as one multiplier per band (DC is counted as a state). Logs must be in GMT, and sent to G. MacConomy, W6BUK, Space 45, 36770 Florida Ave., Hemet CA 92343 no later than April 20.

* * *

On March 5, the Tri-County ARC will hold its Mid-Winter SwapFest at the National Guard Armory in Whitewater WI. The all-day affair will be held indoors and there will be lots of free parking. Tickets are one dollar in advance or one-fifty at the door (an extra buck reserves a display table). Talk-in will be on 3985 kHz. Contact WB9DWG. for tickets and info. His address is RR #4, Box 235, Fort Atkinson WI 53538. Snow-date is March 12.

tions clutter up the whole place. It is true that much of this is illegal operation on the part of other nations, but the spread of 7.0 MHz to 7.3 MHz is not exclusively ham throughout the world. Some countries are broadcasting legally in that range because it is legal for them to do so in their part of the world. They too are supposed to abide by the rule that they should cause no interference to other services. But that doesn't help us very much at all. I'm going to guess and say you go to school. If so, get up an hour earlier (that means going to bed earlier; don't I sound like your parents?). Get up and listen on forty or eight to hear what is on. It's often different from the night. Try three in the morning for more variety. Get the picture? The fewer people there are to crowd the band, the easier it will be to work the few who are there.

What I'm getting at is to listen around the bands and find what is best for you; time, frequency, direction the antenna works best, the weather.

As to transmitting, they'll rarely hear you if you are in the middle of the band. It seems like every Novice has crystals for the middle of the band and uses them all the time. Get closer to the band edges. The closer you can get to the station you want, the more likely he is to hear you. This is a good case for owning many crystals. "Impossible", you say. "Even if the price were halved." MicroComm makes a variable crystal oscillator that is like a VFO; it allows you to swoosh right on top of the station you want to call. Of course all swooshing is done with the transmitter in standby. They advertise in 73, and they only ask forty dollars for the device. That's the price of about ten crystals and this unit works on eighty and forty. A worthwhile investment, I'd say.

As you listen and work around, you'll notice that the bands can change right out from under you. Learn what times the west coast comes in. What time does South America roll in? Does the band change its direction in a clockwise or counter-clockwise rotation? Make graphs or notes in your log so you will be able to tell just what the bands were like when you look through your log thirty years from now.

The key is keen listening. If you can't hear them, you can't work them.

73,

Eric



(From the West Coast DX Bulletin)

If construction of a weather station on the island of Bouvet proceeds as hoped, the call prefix 3YØ may be heard. A ZS1 is being mentioned as the one who will be the operator there. The Spratley Island expedition was not carried through due to unfavorable landing conditions. It appears that the ITU never authorized the use of the call 1S1A and prefers that it not be appropriated. It has been indicated that in such instances where there is no proper call sign that just the call of the operator with the geographical location as a suffix should be given. In this instance, the call might have been WA5VTU/Spratley.

From the Pacific area, the Fijis may change their VR2 prefix for a 3D2, and it seems there is a 3D2 being heard on 20. From Nauru, the C2Ø prefix may only be used on holidays, such as January first. Does anybody know when holidays occur on Nauru? JD6 will be the prefix for Okinawa to replace the KR8 issued by the vacating authorities. KJ6BZ, on most days at 21,285 at 2200Z, has been looking

(continued on page 10)

DX FOOTNOTES

(continued from page 9)

for the Midwest and East Coast. He will return to Johnston on March 2. VR5FX is still very active from Tonga, usually found on 20 CW in the 14,235 to 14,250 kHz range.

Watch for Karl, VE8RA, as he plans to operate from Wallis (FW8) from March 14–22, and New Caledonia (FK8) from March 22–27, possibly until April 3 depending on activity. All bands will be used from each location. When calling, indicate whether you are transceive. Karl will also listen in the General portions of the bands and QSLs will be handled by VE7BWG.

From a remote plantation in Haiti, HH9DL has been heard at 14,220 kHz around 2250Z. Don, the only true HH9 in residence, is also reported as showing up regularly on forty at 7250 kHz at 1230–1300Z. His QTH is at Fort Liberte, thirty miles west of Cap Haitien.

SU1IM and his daughter Dr. Moona, SU1MI, are the only Egyptians currently active. Ibrahim has been trying to get through to the West Coast around 1500Z and after, usually operating in the 14,040–14,060 slot. K6KA has an eyeball sked with SU1IM in Cairo this April. Hopefully they'll make it.

And from the Far East, A5A to A5Z has been assigned to Bhutan. Yontan's SSB signal was last reported as not too strong. He may try the 1600–1700 time period on CW looking for the 6's and 7's. Look for him around 14,045, but he was recently heard at 14,301 at 1200Z.

An ARRL Directors' Letter informs us that a third party agreement has been signed between Trinidad and Tobago and the United States. Since this is the first instance of "British" willingness to allow its amateurs to handle third party traffic, hopefully it is a portent of similar things to come.

DX NEWS

If a direct QSL address is not otherwise available, QSL's for K and W/TF amateurs operating in Iceland should be sent to Keflavik Amateur Radio Organization, Box 44, FPO New York NY 09571.

Box 1058 Reykjavik is appropriate for QSL'ing to Icelandic nationals (TF--) only.

Tell our Advertisers You Saw it in 73

LETTERS

ou goons don't ever proofr
l asy
bu nch f ro ks
you ignored my comments In
I insist that you print ev

I have been very pleased with the good service in changing my address and getting me my 73 magazines. I subscribe to two other electronic magazines, and yours is the only one I have been receiving since I came to N.Z. four months ago.

Ham radio over here is a little different. These guys are homebrew artists! They are known as "Make-do" artists and it is certainly true! I feel conspicuous with all my factory-built gear, and will have to start building again. There is a spirit among the hams and at radio club meetings that I remember in the states back in the 30's . . . friendliness and "shirt off my back" attitudes, etc. They have certainly been most helpful to me. I obtained my reciprocal call with a minimum of red tape and now have K4IF/ZL1BME for a call. I will sit the regular exam and then will have just a ZL call. (This because I have immigrated permanently.)

H. D. Woertendyke
Blenheim NZ

I have my end of the ten meter link in operation and tied into my remote on Harness Mountain. As it now stands, 94 signals heard on my mountain are retransmitted on 29.680 and incoming signals are retransmitted out on 34. Subject, of course, to my control. Anyone listening on 29.680 will hear the Pacific Northwest repeaters along with the "auto-ID." This auto ID consists of a female sexy voice who every 3 minutes says: "This is the W7DXX DX repeater on Harness Mountain in southern Oregon." When the repeater (the 10 meter end) is activated from another 10 meter signal the auto ID sends a CW ID (de W7DXX/DX RPT).

Until you get your end going or someone who reads your comments in this month's 73 gets his going on 29.680 there will be no DX. However, anyone with receive capabilities should hear the Pacific Northwest when 10 is open.

If you wish, give me a call on SSB on 10 and we can coordinate. You pick the frequency and time.

Take a listen to 29.680 for the link and let me know when you are ready to go.

Keith E. Lamonica W7DXX
Springfield OR

Keith's repeater expands the range of the two meter enthusiast many hundreds of times. Can you envision coast-to-coast contacts with a little hand-held unit with a nineteen-inch whip? Think of it.

Having tried many times to learn the code and get a ticket I read with interest WB6JNI article that each letter should be sent at about 20 wpm. W3KBM also made a similar editorial Nov. 1970. Once I had such a code instructor and it helped but he was only substituting.

Could you tell me if any code "tapes" are available that are "skip" recorded? If none are available maybe a reader would be able to make me a "skip" tape of K9AAU "A New System for Learning Morse Code" Apr. 1969.

Ramer W. Streed
3004 So. West Avenue
Sioux Falls SD 57105

Off-hand, we don't know of any such tapes. Perhaps one of our readers can help out here. –E.

I would like to apply for your Real Rag Chewers Award. I have completed the requirements set forth in your Sept. '71 issue.

The calls of the stations involved, WB9EMV (me) and WB9CKG The operators' names are WB9EMV Mark Miller, and WB9CKG Richard Leiterman. The times were from 2300 GMT, December 21st, to 0500 GMT, December 22. We used the 40 meter band with the modes of CW, SSB, AM.

I have been a subscriber to 73 ever since I was a beginning Novice (my only ham mag.). I enjoy it very much and am glad you came out with these fine awards for us without big beams or kilowatts.

Mark Miller
Wauwatosa WI

Other awards available are the WAZP (Worked All Zones Promised). This is a pledge to do just that – a promise to work all 40 zones. The Certificate Haters Club is a solemn oath to hate this and any other certificates that might ever be earned. Less tongue-in-cheek awards that recognize real operating accomplishments include the WAAS, Worked Almost All States. Everyone knows that the fiftieth state is the hardest to work, and this award recognizes the achievement of 98% of the intended goal. And an easy chore for the DXer might be to work ten countries, but the Novice (and some Generals too) has to really work hard to get that many. The DX Decade Club is a large group of DXers who do not make DXing their chief aim. Endorsements are available too. To receive the CHC or WAZP, send a signed statement

swearing to abide by the appropriate conditions. For RRCC, send the calls of the stations involved, names of the ops, and times (GMT) beginning and ending the QSO. For DXDC and WAAS, send the QSLs (package them carefully and include return postage sufficient for first class mail) so we can send them back to you. Naturally, all awards cost one dollar and you can send for them in care of the Novice Editor, 73 Magazine, Peterborough NH 03458.

Well you finally found a type size so small that it cannot be read. I refer to the lack of an index for the year of 1971. Only you would print the December issue without the yearly index.

W. C. Warman W1KVK
S. Burlington VT

The yearly index was postponed because we are planning a complete index from October 1960 to December 1971. All in due time.
Eric

Here's my $6 for another year. I think 73 is the best by far of all the ham magazines. I enjoy it very much and really look forward to the next issue each month.

Another note is on the ads in 73. I really enjoy reading the ads and I like them spread throughout the magazine. Your ads just seem to be more attractive than in the other magazines and I make a point to read all of them. I really like the color ads and especially liked the Regency ad in October.

So keep up the good work and when all the other magazines are gone 73 will still be on top in my book.

Larry Standlee WA5NTF

Our faces are blushing.

I just got my Dec. issue of 73 (my 3 year renewal was just sent in). Like you, I was disappointed in the Dec. issue. I sure hope you get ads to build up 73, also more good articles.

More power from 6146 was a disappointment to me. It's like taking a stock car designed for average 60–65 mph and driving it 95–100 way past design. I like to run things with reserve.

On the subject of interesting QSOs I hardly even run into anyone I wish to sign with quickly. Most of them I look forward to talking to again, I just don't get on as much as I would like.

Orville Gulseth W5PGG
Clarksdale MS

Several months back I bought a copy of your "Amateur Radio Extra-Class License Study Guide." After which time I practically lived with it until taking the Extra examination November 16. Upon completion of it I was told I "almost" passed it, meaning I didn't. Back to the drawing board and the study guide and a return bout on December 14 which proved an overwhelming success, and believe me, I owe 95% of it to you and your genius (genii?) minds for compiling and publishing such a helpful Study Guide. It is most comprehensive in scope and information obtained from it enabled me to understand subject matter that had hitherto been way over my head.

My first try at the examination, and failure, was by no means the fault of the Study Guide. I just had not had enough practical experience with a lot of the subject matter to envision the answers they wanted. The examination showed me where I had spent a lot of time studying subjects that they weren't interested in and by the same token showed me what to expect the second time around.

In general, this is to write my appreciation for making this book available to Hamdon, which has been sorely in need of something like this. It will surely remain a valuable item in my library and I hope other hams feel the same. Without reservation, the genius who put this Guide together has no equal, "par excellence!"

Ross E. Hicks, Jr. W5LPF
Arlington TX 76010

You're welcome, you're welcome. This letter is typical of those we receive in reference to our Study Guides – Novice, General, Advanced, and Extra.

I have received about 100 letters from readers on the "Plug-in Solid-State Vibrator Eliminator" which you have reprinted in the Jan. 72 issue. Most of them ask for additional information and errors if any. Here are the most common questions and answers.

The original circuit shows resistors R1 and R2 and being 44 and 4.4Ω. (A) This was a printing error and should read 4.4Ω each. However the value required may be between 3.3 to 5Ω.

What type transistors did you use? (A) I used Two type 2N443 stud style transistors.

Is there an American replacement for the toroid? (A) To my knowledge there is no American replacement. The Hammond Model 511E is manufactured in Canada by the Hammond Manufacturing Company, Guelph, Ontario. H owever it cannot be purchased direct but through most of the electronic jobbers here.

Do you recommend any other changes? (A) I would install a choke and filter in the 12 volt line to prevent the 200 Hz from getting out on 12 volt line.

Since there. are probably many more readers who might be interested, I have sent this info which should be helpful.

Vern Epp VE7ABK
Nelson BC

I echo your plea for an article on a synthesizer. I am amazed that some of the leaders in solid state devices and accessories haven't seen the need that exists. How about a nice kit? Also how about an article on adding a limiter/discriminator/squelch to AM receivers? Take your old communications receiver, hang an FM receiving adapter on it next to a converter, wire a meter in the discriminator and maybe even a deviation meter, and you have a highly useful instrument that can do quadruple duty.

I'm not smart enough to design these things, but I sure can see a need for them.

Re your suggestion on a repeater contest. Sometimes you have good ideas. This time you didn't. A contest would not be in keeping with the type of operation most repeater users desire. I love contest work, but not the screaming and backstabbing that would go on for the inputs of the machines.

Frank J. Derfler Jr. K9KIC/1

I have been a licensed amateur for 13 years, an ARRL member for the last six consecutive years (I had to join because I could not longer buy the QST over the counter). I have been an IEEE member going on my third year. So you see I do know something about both organizations.

I agree with Mr. Chapin in his Guest Editorial in Jan. 1972 issue of 73. I too feel there is a need to reorganize the organizational structure of the ARRL and update the by-laws and constitution using the IEEE as a pattern.

In Mr. Chapin's editorial only four classes of membership in the IEEE were listed, but there are five grades of membership. The associate member grade was not listed. The grades of membership in the IEEE are (1) Fellow – (2) Senior Member – (3) Member – (4) Associate and (5) Student.

Frederick R. Washburn WA6FJJ
Los Angeles CA

About two months ago I bought a Tempo One w/ac supply from Henry Radio in L.A. In the order I pointed out that my decision was based solely on an ad in 73 Mag.

I like this rig. I had not planned a purchase of this size this year, but the family has grown and left home so funds are available.

This is my first SSB transceiver. So with limited background and experience in this area, I still like it. Using dipoles, if I can hear them, I can work them.

The other night at 7.251 MHz there was a fellow in Ecuador working a U.S. station. Guess what happened? One of our friendly, courteous hams loads up right on freq; 1st the xmttr, then the linear. He wiped out everything. Why can't these people load up a few kHz away and then come on freq?

R. W. Yerbury
Dugway UT

For ten dollars, a person can obtain a dummy load and use it. This would end the headaches of thousands of hams who listen and complain of QRM. It would also keep them from being headaches.

E.

(continued on page 12)

LETTERS CONT.

Tnx for making the DXDC award available; now I have something to shoot for. The following list shows what DX I've worked, and in what order: VE, KL7, JR, LU, OH, TI, KC4, XE, KH6, KZ5, KV4, ZL, VK, KG6, PJ9, and UKØ. The last 4 were in the DX contest (CW, of course). Please don't lose these cards, because I already feel sick about giving them to the post office, hi!

Larry Des Jardin WB6KMW
San Andreas CA

The P.O. got them here all right. They are pretty dependable. The DXDC award is available to all who send proof of two-way QSO's with ten or more foreign countries (and a buck and return postage). Novices, especially might be interested in this award.

My recent QSO with W2NSD Mobile 146.94 direct on 1/3/72 has led me to look into 73 magazine. I discovered a magazine I thoroughly enjoy, just as much as talking to Wayne.

Donn Watson WA2REH/1
Boston MA

You would be interested to know how other Ham publications are rated in this country. I have recently acquired a set of CQ for 1970 and could not find a single useful article. The RTTY column, which used to be one of their regular features, is gone, and there is little else of interest to us in India. The U.S. Library here donated to our club a set of QST for 1970. This bunch had a few articles of interest, but nothing comparable to the articles you run. You might like to know that while no one at Madras subscribes to CQ or QST, my copy of 73 is read by no less than 4 ham families, three of which contain two ticket-holders, in effect a readership of seven.

Let me wish you a bright and prosperous 1972.

M. V. Chauhan
Madras, India

Just had an idea for a ten-minute timer when my daughter's alarm clock broke and I was asked to repair it. Being a ham I noticed the SNOOZE ALARM lasted ten minutes. After five years of thinking, actually about three seconds, it occurred to me that this would make a perfect ten minute alarm for the ham to announce his call and how can you beat that for $2.98.

All that has to be done is disable the regular 12-hour alarm (simple upon examination) and whenever you want the ten-minute timer to work, just pull out the alarm set lever and push down the Snooze button. Ten minutes later the thing can blow up Boulder Dam, turn on your tape recorder, announcing a station break and your call letters. If you don't hit the Snooze button pretty soon it will start the first bars of "Dixie" and end up with "Who Got My Roller Skates." At least it will go off every ten minutes every time you hit the Snooze button.

You can buy a lot of beer or even a vari-coupler and a 201A for the money you save while making the FCC happy.

Clyde A. Welch WA4VKB
Anderson SC

Amateur radio allows a wide variety of operating methods and activities, but there is one type of operation I would like to engage in but cannot – I would like to talk to my wife while I am driving around in the car. Since the chances of her ever getting a license are pretty slim, the best solution seems to be either CB or a repeater with autopatch.

However, after reading the section of your editorial in the January issue about the advantages of using duplex on 220 MHz, another possibility has occurred to me. Why not remotely control the home station with the mobile transmitter? Then the xyl could talk through the home station.

This could be accomplished very easily if duplex were used. A low frequency remote control signal could be transmitted from the mobile along with the voice transmission to simultaneously turn on the home transmitter, activate the station identification circuits and signal the xyl. Each user of the system would have a different remote control signal.

The xyl would operate a microphone switch that would control the modulation of the carrier. This would comply with the rules since they require that only the carrier be turned on and off by a licensed operator. The station would be identified automatically in a manner similar to that used by repeaters.

Full duplex is not required. The repeater would have two separate receivers, but the combined receiver outputs could modulate only one transmitter. This would reduce the complexity and expense of the system and still allow one person to break the other. Most of the time, only one person will be talking at a time anyway. Another advantage is that calling will be simplified since everyone will be listening to the same frequency.

I don't see anything illegal about remotely controlling the home transmitter and operating it in this manner. The main FCC problem would seem to be in obtaining permission to remotely control the home station from the mobile.

I wonder if other readers think this type of operation is legal, possible and practical.

Roy E. Gould W5PAG
4748 DeBeers Drive
El Paso TX 79924

Note in the latest Callbook that New Hampshire is dropping in ham population as is the general count. Hmmm.

Missed the Revoked License box in the last issue. Watch the FCC releases for a bunch from the west coast. Some of them have been jamming WCARS and other communications on 40 and 80, and who knows what all else. One of them said he'd be on the air (just far enough away to splatter on the freq) until someone came by and took his ticket off the wall. Looks like somebody did! They nabbed a kid in Vegas who threatened to fight the president of the net if he showed up in town; as well as the goon who sounded like a pig.

Paul Schuett WA6CPP
Lodi CA

Hallelujah! Congratulations to those who helped rid the air of some inconsiderate ones. Every day we get letters about noise, QRM, and intentional jamming. It may seem like the Golden Rule is outdated and we need force to accomplish the same goals.

But for each bad news letter, we get ten like the following:

Fer the skinny blonde wat sends them 'elp notes from the dunjun. Don't wurry Luv, 'elp is on the way. I just give yore boss sum munny fer that pitchur mikin' book so I can git mi camera going like 'arry Bloggs. 'E blots out chanel 24 and 14 an I wont sum too so pik we out a good wun and if there's any left over send me some of them Mat Dillons an Festuses u got in the cellar. Tell yore boss 'es got a gud thing goin fur us 'ams wot can reed an rite an make things. So don't sen enymore of them 'elp notes. My old lady don't like it and sets the dorg to bitin' me w'ere I use most fer oporatin' my geer w'en it's in vox. An my cher don't 'ave no cushin. An tell Big Ears 'e ort to go fer ARL direktur an git us sum sence out of Charlie wots givin' away our bands. Don't fergit to send mi TV book kwik.

WA8QXU

Any activity on 10 meters FM? What does FCC think of 2 meters to 10 meter repeaters (or vice versa?) Anyone trying it successfully?

Barry Foote K1BTF
Framingham MA

Yes, there is quite a bit of activity on 29.6 MHz, particularly with low power rigs. On 29.68 MHz there are a growing number of repeater links to two meters. W7DXX seems to be pioneering this, though other repeater groups are reported getting into the action. Look for WA1KGS in Waltham to be linked to 29.68 soon . . . and others. It won't be long before two meter groups will be in contact with each other via 29.68 links . . . and, as W7DXX asks, how long will it be before someone driving in San Diego is talking with someone in Munich? Not long! DXX has already been pioneering some 20m links and recently the two meter gang had a chance to work UAØZAR via the repeater.

Due to my future husband, WA4GPJ, I have become an avid fan of 73 and amateur radio. I really enjoy 73 and although I don't understand all the technical articles, some of them are actually sinking in!

I have copies of every 73 from August 1970 through September 1971 in which you published a series of articles on the General Class License. Unfortunately I don't have a copy of July 1970 which contains the beginning article. Is there any possibility of getting a copy of General Class License Part I? The articles are well done and the progress is logical *and* simple. So many of the License Guides assume that one knows a lot of technical knowledge.

It would also be great if you could print articles for XYL's who could enjoy their husbands hobby instead of being a "Ham widow." I am delighted that Jerry is urging me to get my ham license. In fact, for Christmas he gave me a code key and a code oscillator, all rigged up and ready for me to operate. What more unusual Christmas gift could a future XYL get? By the way, I found the code very easy, considering the fear I had before getting started on it. Could you compare it to going to the dentist – "The I-know-it-is-going-to-hurt bit?"

Again, I really enjoy 73 and especially your editorials and humor that appears in the oddest places. You might say I think that 73 is terrific.

Ann Largent
Richmond VA

Ann, all the best to you and Jerry. Your missing copy is on the way with our blessings. The number of YL and XYL articles we print is about proportionate to the number we receive; maybe you will share with us your experiences after the big day. By the way, I read of another ham who gave his fiancee a code practice oscillator in kit form and made her build it in front of him. In comparison, Jerry sounds like a pretty good guy.

I reread your December editorial for the second time after letting it sink in for a couple of weeks or so.

I guess you could consider me a DX'er of sorts, or a rag chewer of sorts, or one who really cares about the chap on the other end, thousands of miles away. I have confirmations for DXCC at 241 and I don't really feel it is all that important to get 242 unless it comes easily.

I have operated from "CT1" and I also hold G5AUP in U.K. When I'm in this country I like to work the boys in Europe and around the world. When in Europe I like to work back this way. It's nice to work Father Moran (9N1MN) from NJ, but it's fun shaking him up from my London location, too. Why? Because he is concerned; he remembers about you, your friends, etc. Something personal, you see, is the key.

You won't get rid of the phone-patch gentlemen in the rare DX part of the band until you educate them as well as respect them on their part of the band. Sort of a gentleman's agreement you might way.

Now let's get down to the real biz of making a meaningful QSO.

It is important to really listen to what the other fellow or lass has to say. Don't be afraid to comment and above all have something to say, not just rst, QTH & name. Find out if he makes wine for a hobby or watches mini skirts. Judging by his accent you might ask if he is possibly from a different part of the world. What can you find in common with the other op? Follow this up if it was a good chat and make a file card on him. Next time ask him how his wife and kids are. What a surprise for him that you not only knew his name, but you knew his family, too. It takes hard work to acquire this type of feel for things. It will pay off tenfold, I assure you.

I keep track of over 3,000 people outside of the USA and I assure you it doesn't take me more than ten seconds to know my man or woman at the other end of the DX band on either CW or SSB, 10m or 16m.

I don't think I have anything special going for me except I don't make it a practice of asking for a QSL with my first over – Hi.

The other day I had a 1 hour QSO with a 7Q7 on 14.255 MHz. It must have been more than a report and how's the WX. It must be frustrating for a chap who needs 7Q7 and could care less about our chatter. But for those who were kind enough to stand by and not lose their heads, it paid off, for this 7Q7 was in a good mood then.

Chances are I will be talking to him again soon and by past experience he will know where to look for me and will probably call me.

Many amateurs don't know that for each working op there may be ten listening to your QSO. Some of my new-found friends are really old friends in a way as some tell me, "I listened to you for over two years before I got my ticket" or "We like what we hear and feel we really know you."

Try to work in and around the same frequency from time to time. Get to know the people well. Check that freq. at least twice before making that "CQ Europe." They size you up quickly and they can cut you down just as fast. Try to understand what makes people tick. Do the unusual. Talk about things not related to radio. Ask him about his country and what a loaf of bread costs. How many hours of work to buy a certain item, and so on. In other words, get involved. Above all, be sincere, be helpful, speak slowly to a chap who has trouble with English. Use small words. Be patient.

I assure anyone it works. I have skeds with Europe and Africa on a regular basis, and I have had visitors from Greenland, Denmark, England,

(continued on page 14)

(SSTV Scene cont. from p. 5.)

Well, if you are still looking for African QSO's listen for ZS3B on either 14.230 or 21.340 around 1900–2100 GMT. ZS6PP also frequents 21.340, often around 1630 GMT, EL2BC should be getting his Robot gear by now also. Watch for him also on 21.340. Generally, the Europeans and Africans are leaning toward 21.340 activity with 14.230 as a secondary choice. Much activity, also, from down under (VKS and ZLS) but this'll call for the midnight oil. They generally show around 0800–0900 GMT on 14.230 (twenty is starting back its "Late Night Re-Openings" a little early this year).

We've been "looking in" lately on the Canadian SSTV net, which meets on Sundays and 2200 GMT on 14.180 kHz. Very good pictures – some real candid shots – and a lot of info exchanged. Look in some Sunday, I think you'll like it.

The year 1972 promises to be an outstanding year. The advent of 50¢ integrated circuits, $5 phase-locked loop IC's and availability of 12–16 inch P7 phosphor cathode ray tubes, should be a real boon to SSTV. WØLMD has proven his all integrated circuit, magnetically deflected monitor for over a year now. So it should be appearing in print soon.

If you can't wait, and Sid can't furnish you with a diagram, send me an SASE and I'll drop you a copy. The monitor has bandpass filters and a tunable SYNC detector circuit, which really proves itself on marginal signals. Also, this year, watch for more information on the larger screen monitors, slow scanned cameras and new ideas on flying spot scanners. And watch for Heath to come out with a nice monitor for under $250 – maybe an SB205.

The Dayton Hamvention is coming up again in late April and, as usual, much slow scan activity is planned. Many of the new ideas on SSTV were first presented at the Dayton convention, and I'm sure this year will be no exception. Everyone will bring diagrams of their "brainchild" to the SSTV booth, and many of the top SSTV'ers are usually around.

Possibly Don Miller W9NTP, will unveil his SSTV handbook there this year.

The second W.W. SSTV contest should be over by the time this appears in print, so why not drop a postcard to me giving your results and score. Results will be tabulated, and I'll report the new "Big Guns" in this column. Send along pix or tapes of interest also. I'll photograph an interesting picture or so for possible publication in this column later.

. . .K4TWJ

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agencydiscount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor. . .

STANDARD SRC-145, Japanese equivalent to the SRC-146 hand-held unit for 2m FM. With simplex crystals for low end of band. First certified check for $200 to Box N, 73 Magazine.

BALUN – 2KW, 1:1, with coax fitting and dipole insulator, Teflon insulated wire, epoxy encapsulated, $8.95. Plate Choke 2A., 5KV, $6.45. Dual 30A. shielded filament choke $6.95. ppd. U.S.A. GREGORY KORDES, Box 1279, Tustin, California 92680.

(continued from page 13)

Portugal and others. I have also done the same myself. I assure you that when you visit a foreign land and you meet your friends they will show you and your family things no regular American would usually see.

What amateur in a foreign land would put up a 60 ft crankdown, tilt-over tower with beam at his country place with wall-to-wall American gear for my use during my stay? You say, he's kidding. Not so – I will show doubters color pictures.

Would you believe a very important man in his country took time off from his important duties to be a guide for my wife and me?

Could you imagine that a gentleman in one country who said he would meet us at the airport sent two dozen red roses to our hotel because he was called away to HB9 land, but another amateur and his wife drove 50 miles during the night to be there waiting with my QSL card in his hand so I would know someone cared.

This has only been a small sample of what can happen if you let yourself be involved.

Amateur radio can do more for international good will than our State Department has over the years.

Think of it in another way. What can I do for amateur radio? How can I get involved? Is that QSL all that important? (It will come in time, anyway.)

Paul T. Atkins WB2OZW
Park Ridge NJ

ROCHESTER, N.Y. is again Hamfest, VHF meet and flea market headquarters for the largest event in the north east, May 13th. Write WNY Hamfest, Box 1388, Rochester, N.Y. 14603.

HOOSIER ELECTRONICS Your ham headquarters in the heart of the Midwest where only the finest amateur equipment is sold. Authorized dealers for Drake, Hy-Gain, Regency, Ten-Tec, Galaxy, Electro-Voice, and Shure. All equipment new and fully guaranteed. Write today for our low quote and try our personal, friendly Hoosier service. Hoosier Electronics, Dept. D., R.R. 25, Box 403, Terre Haute, Indiana 47802.

73's – Vol I No 1 to date. Some bound – Some with minor cover damage. Best offer within 30 days. W3CJY, 6281 Akron St., Temple Hills, Md. 20031.

B RAND NEW coax connectors PI-259 (male) or UG-260D (BNC male) 7 for $2.00; nice low impedance headphones reconditioned $5.00 each; New carbon paper black typewriter ribbons for IBM Executive models A, B, C $1.50 dozen. All plus postage. Bill Hayward WØ PEM, 1307 NE 57th Terr., Gladstone, Missouri 64118.

FCC "TESTS-ANSWERS" . . . Original exam manual for First and Second Class License. – plus – "Self-Study Ability Test." Proven! $9.95. Satisfaction Guaranteed. Command, Box 26348-S, San Francisco 94126.

7289 (3CX100A5) ceramic sub for 2C39. Surplus. Pre-checked at 449 MHz & guaranteed. $3. ea.; $30 doz., plus postage. Ed Howell, Folly Beach, S.C. 29439.

SELL: Copper clad, both sides, epoxy board 3x24x1/16 $1.25, 3x21x1/16 $1.00, 3x18x3/32 $1.00 post paid. Vernon Fitzpatrick, WA8OIK, McLain Park, M-203, Hancock, Mich. 49930.

2 MTR. POWER SUPPLIES
Solid state, Regulated, overload protected 117V AC in/13.5V DC @ 3 Amp. out. Only $22.95 & $1.00 POSTAGE. Limited Quantity. Low, Low Prices on Japanese 2 mtr Gear, Free Catalogue. GLENWOOD TRADING CO., Box 1009, Blaine, Wa., 98230.

TELETYPE: Model 14 typing reperf, $28; CV-278/GRC late model FSK converter, $105; 40 rolls 11/16" perforator tape, $8. Jim Cooper, POB 73-M, Paramus, NJ 07652.

DRAKE 2C, Xtal Calb., with 2 CQ and Drake 2NT Xmtr. $300.00. Like new. Bart Burne, WN3QXU, 1725 Wyoming Ave., Scranton, PA. 18509.

YOUR CALL LETTERS. Two sets, for windshield and rear glass. Smart white letters with red outline. Easily installed pressure sensitive decals. $1.00, postage paid, anywhere. Satisfaction guaranteed. Lake Jordan Artists, Slapout AL 36092.

GREATER BALTIMORE HAMBOREE. Sunday April 9 at 10 A.M. Calvert Hall College, Goucher Blvd. and LaSalle Road, Towson, Maryland 21204 (1 mile south of Exit 28 Beltway-Interstate 695), Food Service, Prizes, Flea Market, $1.50 Admission, NO TABLE CHARGE OR PERCENTAGE.

EVANSVILLE, Indiana HAMFEST 4H Grounds (Highway 41 North 3 miles) Sunday, May 7, 1972; air conditioned, auction, overnight camping, ladies' bingo, reserved flea market booths. Advance Registration. For flyer, contact Morton Silverman W9GJ, 1121 Bonnie View Drive, Evansville, Ind. 47715.

WANT CLEAN COLLINS 51J-4, also Drake C-4; with manuals and original shipping containers. No junk! First letter give each serial number, condition, price; also price for both, if have both. Watson, 700 West Willow Street, Long Beach, CA 90806.

MOULTRIE Amateur Radio Klub, 11th annual Hamfest, Wyman Park, Sullivan, Illinois, – April 30, 1972, Indoor-outdoor market. Ticket donation $1.00 in advance – $1.50 at the gate. Open 8:30 A.M. W9BIL – 146.94 MHz. M.A.R.K. Inc., P.O. Box 327, Mattoon, Illinois 61938.

ROBERTS 50 watt AM/FM Stereo Receiver $100 PPD. – Picture. Past issues radio magazines wanted! Thomas King, 340 Water, Platteville, Wisconsin.

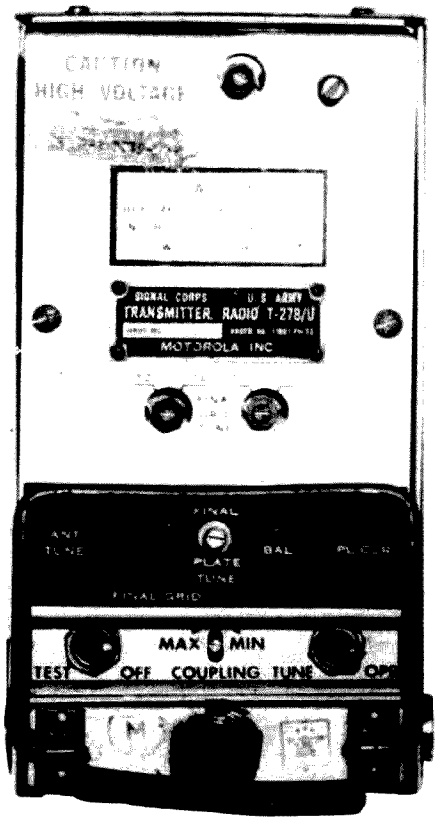
FOR SALE: 2 meter FM remote base with 450 control, includes tranmit and receive on 34, 76, 94, with KW and 450 repeat, with auto patch and yagi beam for 2 meters and various other remote and repeater goodies. Contact Keith W7DXX (503) 747-1685.

2-METER FM INOUE IC-20, Brand New, 1 & 10 watts, solid state, 12 channel, w/Xtals, w/accessories, $235.00, Bob Brunkow 206-747-8421, 15112 S.E. 44th Bellevue, Washington 98006.

21ST ANNUAL DAYTON Hamvention will be held on April 22,1972, at Wamplers Dayton Hara Arena. Technical sessions, Exhibits, Hidden Transmitter hunt, Flea market and special program for the XYL. For information write Dayton Hamvention, Dept. S, Box 44, Dayton, Ohio 45401.

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Sam Kelly W6JTT
12811 Owen Street
Garden Grove CA 92641



Converting The T-278 TRANSMITTER For Two Meters

The T-278/U transmitter is a two channel crystal controlled FM transmitter. As issued, it covers 152–174 MHz with a power output of 25W. It is most commonly encountered as part of the AN/VRC-19 mobile transmitter-receiver, but is used in a wide variety of other configurations. The transmitter requires a separate power supply and controls. Normally a DY 93-G power supply is used, but there is an ac supply, PP-804/U, which is used for base station configurations.

Conversion consists of building a power supply, control circuits and a slight modification to the final amplifier tuning capacitor. Figure 1 is a schematic diagram of the power supply and control unit. The connections between the power supply and control unit and the transmitter are simplified if you remove the existing connector and use a terminal strip for the power leads. A small butch plate can then be installed to mount two BNC connectors for the antenna and receiver antenna connections.

After you complete and check out the power supply and *before* you connect it to the transmitter set the filament control so that the wiper is on the maximum resistance side. Then connect the power supply to the transmitter. Turn it on and adjust the filament control for 1.25 volts as measured at the test point.

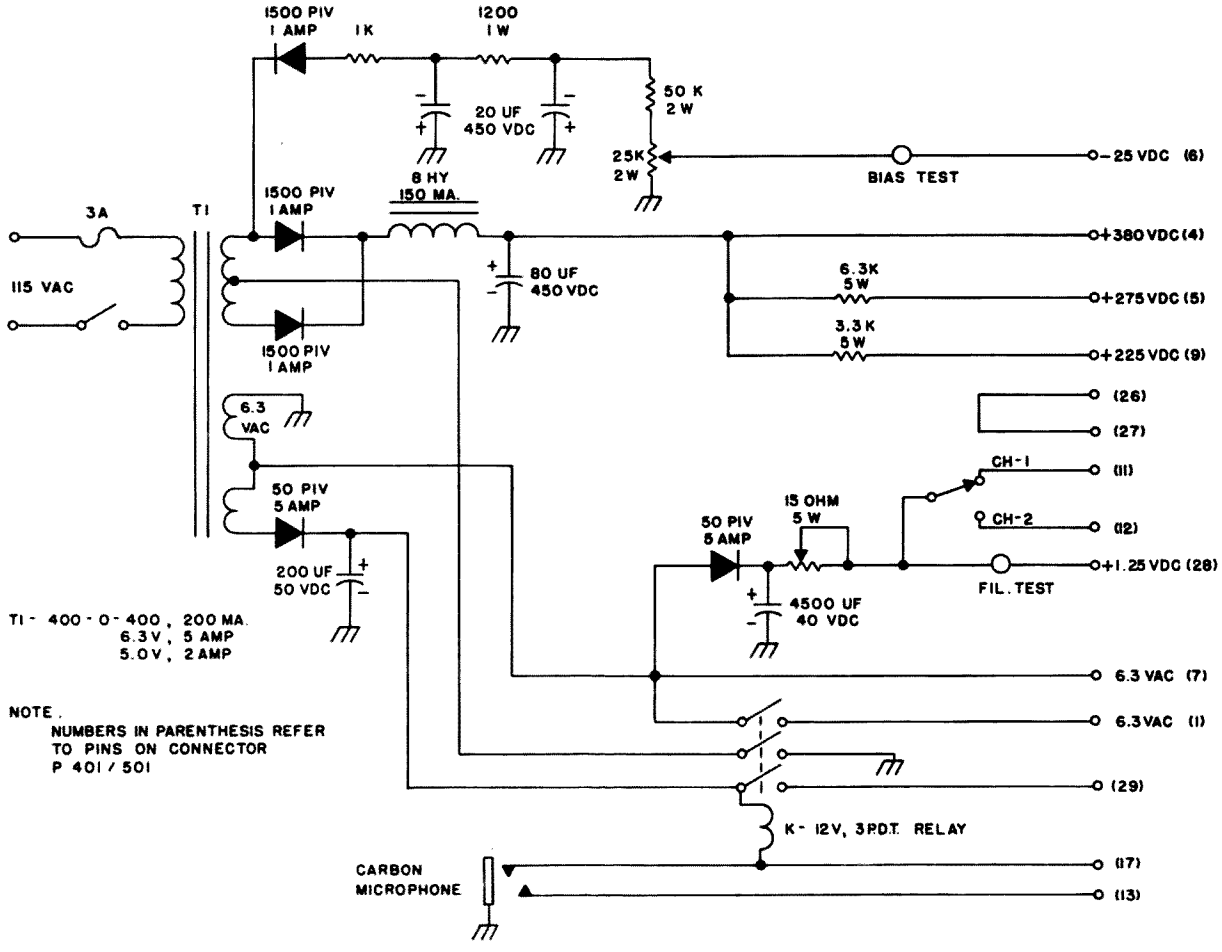


Fig. 1. Power supply and control T-278/U transmitter.

The crystal frequency is calculated by dividing the desired operating frequency by 32. Crystals should be ordered as CR-27/U type for use in an oven. Install the crystals in the oven and set capacitors C-403 and C-404 to their midpoints. For two frequency operation it will be necessary to install a second 1AD4 in the socket labeled V-402. The second frequency cannot differ by more than ±1 MHz from the main frequency.

Allow the set to warm up for at least 15 minutes before proceeding with the following alignment. This time is required for the crystal oven to stabilize. Check to insure that the crystal oven is rated at 6V.

Alignment

1. Modification of the final tank circuit. This modification is not necessary if you are going to operate above 147.5 MHz. For coverage of the entire band it is necessary to solder two 1 in. diameter thin copper disks to the existing disk capacitor. Satisfactory disks can be made from a scrap of copper or brass sheeting, or the disks found in between 88 mH loading coils can be used.

Check the operation of the sliding shorting bar. It can become erratic due to corrosion. In any event the fine pitch tuning screw is difficult to tune. The shorting bar is easily removed. Tuning is then entirely accomplished using the disk capacitor.

2. Place the test switch in the test position and the tune-operate switch in the tune position.

3. Connect the common lead of a VTVM to the chassis and plug the probe into jack J-401. Adjust Z-401 for maximum negative voltage. Detune to 90% of maximum. Move probe successively to J-402, 403 and 404 adjusting Z-402, 403 and 404 successively for maximum negative voltage. Nominal voltage at J-404 will be about 70V.

4. With the probe in J-405 (driver grid), adjust Z-405 and C-429 (driver grid tuning capacitor). There is an interaction between

these controls so repeat the procedure several times. Nominal voltage at J-405 is −55V. If a peak cannot be reached it may be necessary to solder a 5 pF padding capacitor across C-429.

5. With the probe in the final grid jack (J-406) adjust the final grid tuning capacitors and the driver plate capacitor for a maximum negative voltage.

6. Connect the VTVM across the plate current jacks. Watch out! The jacks are at plate potential. The meter reads 100 mA for each volt.

7. Connect the antenna. Adjust capacitor C-448 for minimum current. Adjust the loading capacitor and the antenna coupling for maximum current while retuning C-448 for a dip. Place the tune–operate switch in the operate position and readjust capacitor C-448 for a dip. Adjust the coupling link to limit the plate current to 150 mA (1.5V dc).

8. Disconnect the VTVM from the plate current jacks and reconnect it across the balance jacks. If the final tubes are balanced the reading will be zero. If they aren't balanced it will be necessary to adjust the final grid tuning capacitors to establish balance.

9. Place the test switch in the off position and the tune operate switch in the operate position. The set is now ready for use.

If no modulation is noted, check for a 2V dc voltage on the microphone jack. If no voltage is present, you have an early set that hasn't been modified. To modify unsolder pin one of the microphone input transformer T-401 from ground, and reconnect it to the wire going to pin 15 of the connector. This will provide dc for the carbon microphone.

In practice, the transmitter has been used for both voice and AFSK RATT. The 600Ω audio input (pin 14) is used for teletype.

Precise frequency adjustment is provided by adjusting capacitors C-403 (frequency 1) and C-404 (frequency 2). The best bet is to have the net control station talk you on frequency as you adjust these controls.

I was worried about the reliability of the 1.25V filament tubes. This turned out to be groundless as the set has been in use for over a year without a single tube failure.

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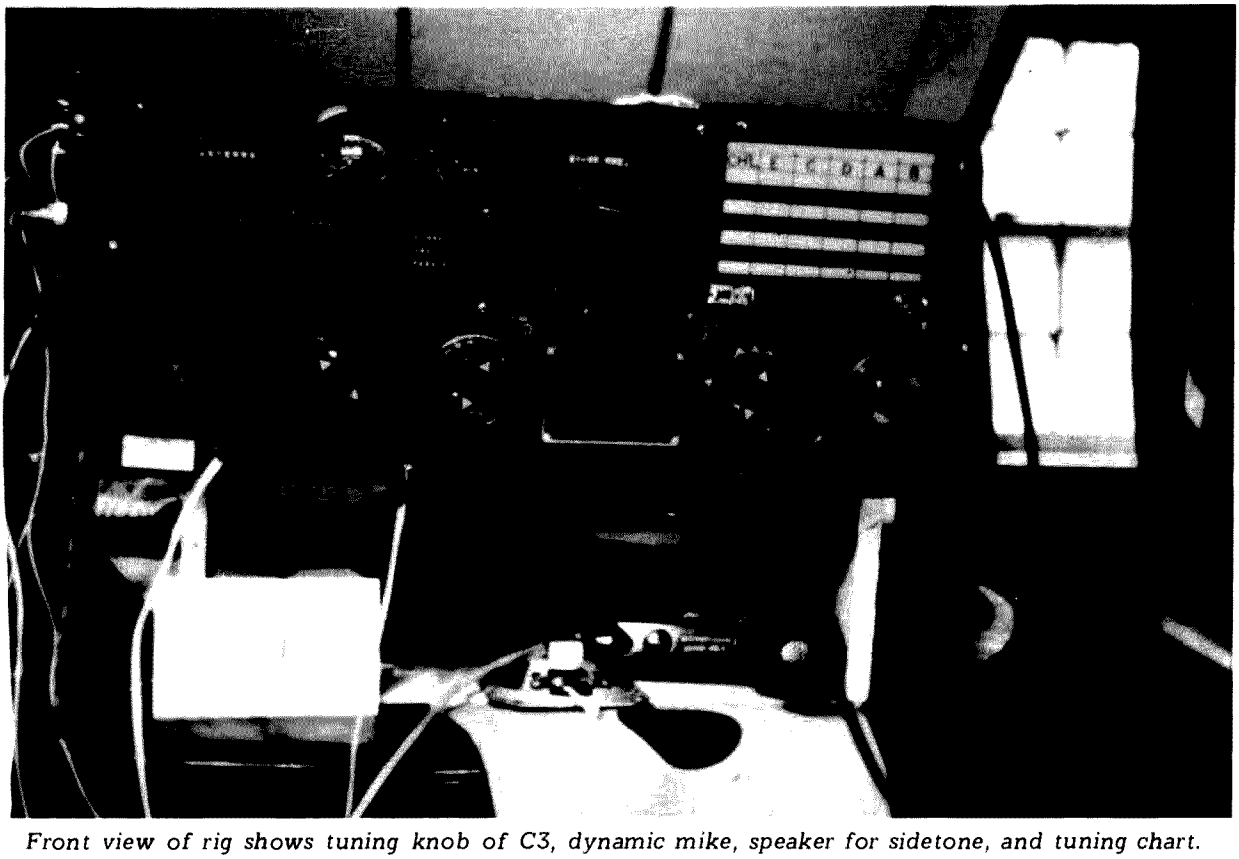
Allen W. Porterfield, Jr. W2ISL
41 Winnebago Road
Yonkers NY 10710

Easier Conversion of Surplus Transmitter AN/ARTI-13

120V ac Power Supply

Earlier conversions of the ART-13 transmitter used the 24V dc relays from the separate dynamotor. In Fig. 1, I used no power supply relays because, like most buyers of this rig, I received no dynamotor. Two ac power supplies are controlled by primary 120V SPST switches.

The VFO supply is fixed with a voltage between 400 and 450V filtered dc. The 813 power supply is 0–3500V. A 20Ω 1W resistor added to the negative lead of the



Front view of rig shows tuning knob of C3, dynamic mike, speaker for sidetone, and tuning chart.

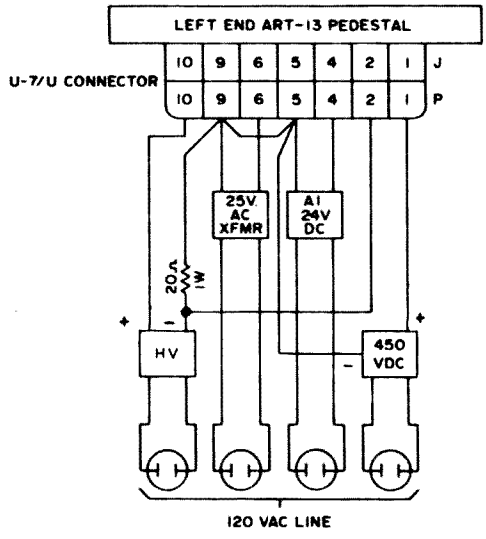


Fig. 1. Power supply arrangement. Parts are: 25V transformer: 100W Lionel Corp. (or 2 12.6V, 4A); 24V dc: Two 10A 12V dc battery chargers; 450V dc PS: 225 mA minimum, 300 mA max. (see text); HV PS: 1200V to 3000V, 200 mA (4 866 rectifiers); Resistor: 20Ω (20.1Ω) 1 to 10W (on left end).

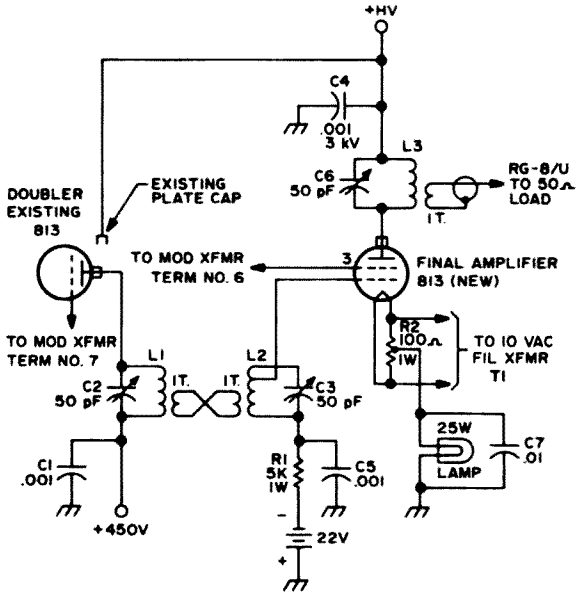


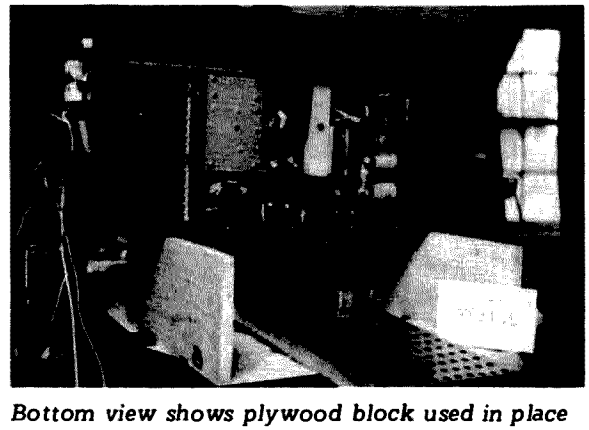
Fig. 2. Ten meter diagram. Parts include: Medium base porcelain 25W lamp holder; L2 – 4 turns No. 18 on 1¼ in. form-tap third turn; L3 – 3½ turns No. 14 on 1½ in. Hammarlund ribbed 4 pin plug-in form; T1 – transformer 10V, 4A, Zenith 7.5V and 2.5V series to add.

larger supply gives instrumentation like the original. The existing panel meter reads 0–200 mA of 813 plate current in the CW position of the emission switch. Plate volts may go to 3000 on CW. in the VOICE position, plate volts should not exceed 1250 because the plates of the 811As go pink and the percentage of modulation is lowered. The OFF position of the emission switch is not used. Neither is the cover interlock used (only 7 of the 10 pins in the U-7/U connector are used). Two 12V automotive battery chargers at 2 amps continuous duty operate the auto tune motor, etc., without filter or hum.

10 and 15 Meter Output

There are no soldering changes nor drilling of the basic Collins rig. The 813 tube becomes a doubler. Figure 2 shows the change of the plate circuit by changing the plate cap. Existing antenna terminal, RF ammeter and C, D, and E front panel controls are not used on 10, or 15 meters. The 813 doubler operates from the 450V power supply drawing 80 mA at resonance raising the 450V power supply current requirement to 300 mA. In the space left by removal of the LOW FREQ Oscillator, the 10 meter final is installed using a second 813. The plate current in this tube is read by the existing meter. Doubler resonance is found when the final plate current is peaked. A grid drive of 3 mA (external meter for initial tuneup) is sufficient to produce normal plate current on the 813 final. The PA GRID meter switch setting continues to read the input to the 813 doubler.

The aluminum bottom of the rig must be removed to peak the 1625 multipliers



Bottom view shows plywood block used in place of metal bracket.

for 10.5 MHz and 14.2 MHz putting the pointer into the acceptable center scale range – 8.5 mA of grid current. A single turn loop around the 29 MHz coil couples the RG-8/U coax to a 1 kW amplifier at W2ISL.

The RECEIVER terminal should be connected to the receiver antenna terminal with coax (shield goes to ground connections). The microphone used has a switch to control the entire transmitter without hash in the receiver when not transmitting. A dynamic microphone is used from a surplus MARK II 19 set (new 3 conductor shielded cable) with a PJ068 plug. Ventilation holes in the sides of the rig suit RG-8/U coax. The final tuning capacitor is mounted on ¼ in. plywood (as insulation) in the vicinity of the coil L3. The grid tuning capacitor also used plywood as insulation with an insulated flexible coupling to a 2 in. long ¼ in. shaft that passes through a *new* hole in the MX-128 panel (described in *Surplus Schematics* by Cowan Publishing Co.).

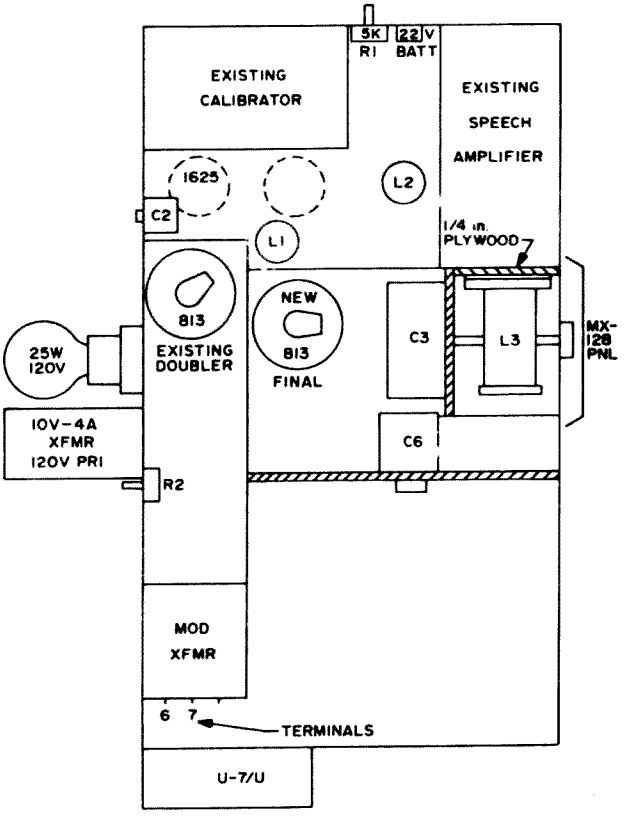
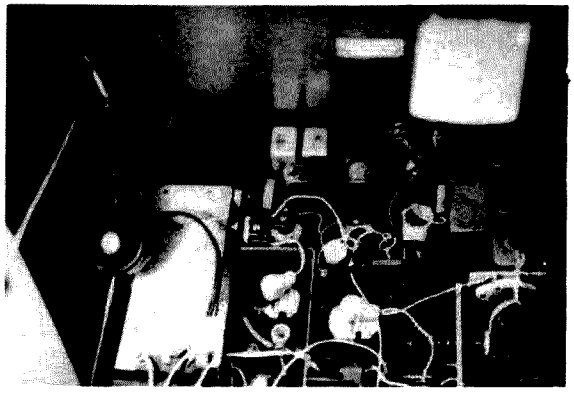


Fig. 3. 10 meter output modification.



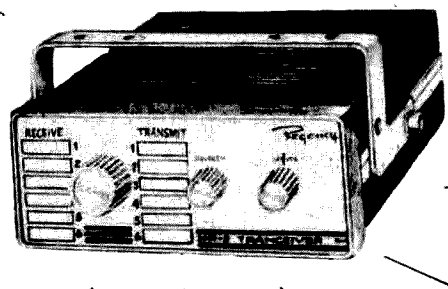
Close up top view shows coil location. L1 is 6½ (No. 14) turns on a 29/32 in. wood dowel. All three coils have generously spaced turns.

Link coupling from the doubler plate to final grid coil was used so that the doubler could be tuned to resonance at 29 MHz before and after the final was installed. An attempt to plate and screen modulate the 813 doubler was unsatisfactory. Shorting 2/3 of the turns of the final coil permits doubling in the second 813 for CW output on 6 meters. Circuit constants in the Figures are for 29 MHz because an AM carrier is feasible on 10 meters but not 15. Since the screen of the doubler 813 is not modulated, the G2 connection on terminal 6 of the 811A output transformer must be moved to terminal 7. A new insulated lead is run from terminal 6 to the screen (G2) at lug 3 of the new final 813 socket. Transformer terminals are theaded with nuts.

To save the $5 cost of USAF-NAVY *Operating Instructions* a table lists A and B control settings for band edges and 50 kHz higher.

FREQ. (kHz)	A	B
3500	3	1333.7
3550	3	1455.7
3900	4	673.4 calibrator check point
4000	5	100.1
7000	7	1333.7
7050	7	1394.6
7200	7	1578.9 calibrator check point
10,500	9	1333.7 15 mtrs
10,525	9	1354.1 15 mtrs (advanced class)
12,500	11	407.5 WWV check and 6 mtrs
14,000	11	1333.7
14,050	11	1364.2
14,400	11	1578.9 calibrator check point

IMPROVING YOUR HR-2



Note: The author of this article is T. L. Greenman WA1KFZ who can be heard daily working CW through the 04/91 repeater on Mt. Greylock, Mass.

Regency HR-2 transceivers are great little rigs for the money: however, like all other ham rigs, there is always room for improvement.

If you are a proud Regency owner and live where split channel repeaters exist, you know co-channel selectivity can be a problem. The HR-2, .2A (03-04 serial prefixes) use a single ceramic filter in the 455 kHz i-f strip for all the selectivity. The easiest way to improve the selectivity then is to change this filter for a more selective unit. The sharper filter which cures the problem without causing other problems is a Murata Model CFR 455D which may be obtained from Murata Corp. of America, 2 Westchester Plaza, Elmsford, New York 10523. Prices are $14.30 each or $11.30 for 3 or more.

The new filter pin locations are shown in Fig. 1. The new filter is longer and narrower than the original filter and its installation requires the drilling of 4 new holes in the P.C. board for its installation. In case Murata changes the case tab location with respect to the ground leads, check the two ground pins with an ohmmeter for continuity.

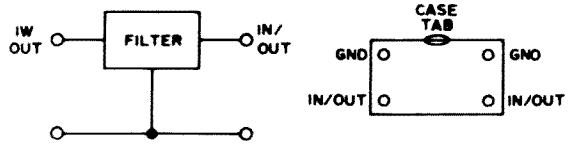


Fig. 1. Schematic diagram.

To install the new filter:

1. Remove the old filter using a small (37W) soldering iron, taking care not to heat the board or pin excessively. The easiest method is to remove the solder from each pin, and then push the filter out.
2. Next, using the new filter pins as a locator and Fig. 2 as a guide, drill four new holes (3 for leads and 1 for case tab). Index the new filter on the lower left pin hole as in Fig. 2.
3. Place the filter into the holes and carefully solder the five places.
4. Inspect the board carefully for solder shorts, etc.
5. Put the unit back into its case and turn on the receiver.
6. Find a channel with a weak signal on it and, using a diddle stick, adjust the quad coil (the i-f looking can next to the relay contacts) for clearest audio.

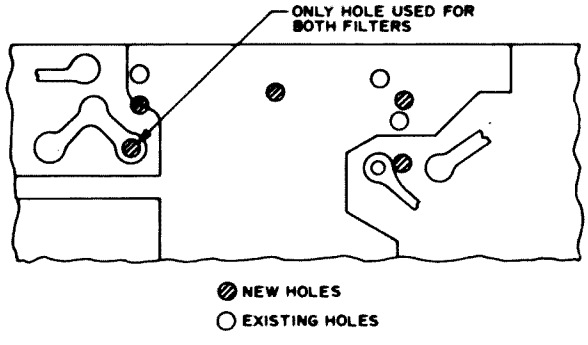


Fig. 2. Bottom view of receive board. Front panel on right.

Your selective receiver is now ready to go. You may notice a slight change in the squelch control action, and a slight improvement in receiver sensitivity.



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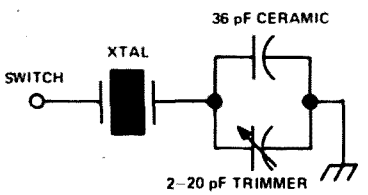
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12 Channels with the Regency HR-2

Gleaned from The Squelch Tale *publication of the Northern Berkshire Amateur Radio Club (WA1KFZ repeater), and submitted by WA1KJI.*

Six channels may be adequate in most parts of the country, but on those areas where repeaters are springing up every few weeks, a few extra crystal channels could help.

Fortunately the Regency HR-2 comes with a twelve position channel switch, so all you have to do to expand its coverage is add six more sets of crystals for the transmitter and receiver. There is room in the HR-2 for these, particularly if you are using an external speaker.



The process is simple. The six channels built into the HR-2 run down to the crystal sockets as you can see on page 12 of the instruction manual. All you have to do is add six more crystal sockets on a piece of Vector board 2¼ x 1 with .062" holes on .2" centers, plus six trimmers and six 36 pF capacitors per Fig. 1. Run short wires from the crystals to the switch and ground the other end of the circuit someplace handy. You can work out the mechanical problems or just tape things together, as you wish.

MORSE CENTENNIAL

Next April 2 will mark the 100th anniversary of the death of Samuel F. B. Morse. It is hard today to realize how great a debt the world owes to this painter-inventor and the magnitude of his contribution not only to American life but to communications all over the civilized world. His experiments proved that using a predetermined code, human intelligence could be transmitted long distances over a wire, with the speed of light.

He was born in Cambridge, Mass., 1791, and died 81 years later in 1872 in New York City. As a student at Yale (with a flair for sketching) he attended lectures on the new marvel, electricity. He and his brother Sidney invented a pump which was used on fire engines.

But he needed a means of livelihood and for 22 years he painted portraits in the United States and Europe, where most American artists studied in those days.

In 1832 he learned that a magnet was created if an insulated wire was wound around an iron core, and an electric current was sent through the wire from a Leyden jar. He felt that this property could be used to transmit human intelligence. He made numerous sketches of such a system, and this led to his devising a crude sending apparatus and a code with which to identify the message.

From 1832 to 1837 he worked on his invention at New York University where he was a teacher of the art of design and eked out a poor existence by painting portraits, too.

In 1843 Congress voted $30,000 for the construction of his experimental telegraph line between Washington and Baltimore, and on May 24, 1844, Morse sent over the line, in the presence of many high officials, the famous message "What Hath God Wrought!"

There were other efforts to devise practical telegraphs all over Europe, but all of them were visual systems, leaving no record of the messages. Morse's machine, on the other hand, left a record on tape and was the first practical recording telegraph.

Within a few years the whole Eastern United States was covered by short telegraph lines. Finally, in Rochester, N.Y., a movement began in mid-century to merge a number of them and within a dozen years more than fifty of the various lines had been combined into the Western Union Telegraph Co., which eventually covered the whole country. By 1862 a wire reached California, just seven years before the first transcontinental train got there.

Museums, colleges, railroad organizations, art galleries, professional and amateur telegraph associations, radio, television and historical bodies all will mark the centenary of the death of Samuel Finley Breese Morse, the man who annihilated space, on April 2, 1972. He died in New York City and is buried in the beautiful, park-like Green-Wood Cemetery, Brooklyn, N.Y., under a 15-foot-tall monument, surrounded by the graves of 34 of his kin.

Amateurs interested in more information on the Morse Telegraph Club should write to Joseph B. Milgram, President of the New York Chapter, 952 East 19th Street, Brooklyn NY 11230, to whom we are indebted for this item.

Robert L. Grenell, ex W8RHR
3926 Beech Street
Cincinnati, Ohio 45227

UPDATING AN OLD RECEIVER

You who fear to insert the tip of your soldering gun beneath the lid of your factory-made equipment, read no further. This article will blow your minds, for the project it describes involves removing the crystal filter, diode detector, noise limiter, and part of the avc circuitry from an "outdated" diode detector AM/CW receiver. The parts and circuits removed are then replaced with circuits and systems designed for the best reception of SSB, including just about the smoothest audio-derived agc system to be found anywhere. My conversion project was a 75A2, but the principles and circuits can be used in converting any receiver.

I am presently in the throes of relearning the code. I unwittingly let my W8RHR license lapse through simple inertia, and now must pay the price. (Why don't they make CW men pass an elocution test?) When I'm not copying practice code, I spend my time building and rebuilding, hoping to be ready next spring with a rig which will do justice to the excellent conditions which will prevail on the DX bands when I make my re-entry into the world of amateur radio. Naturally, I'll be

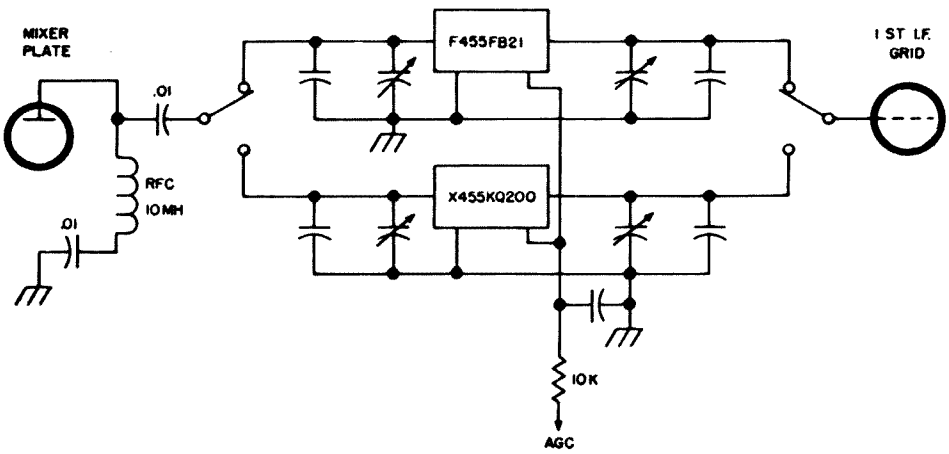
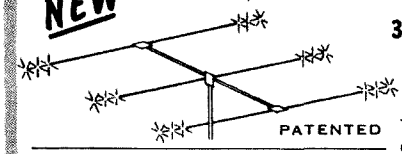


Fig. 1. Installation of Collins mechanical and crystal lattice filters. Fixed padders are 82 pF silver micas, and variables are 50 pF air trimmers.

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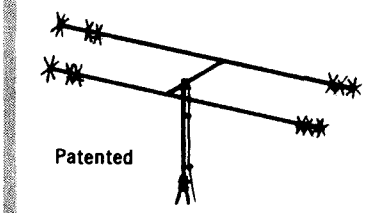


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SSB. The first project on the agenda, therefore, was the conversion of the 75A2 I purchased from a local ham. Of course, a mechanical filter. And a crystal lattice for CW. And a good product detector and agc system with suitable noise limiting. This article is devoted to all of those who have failed to achieve the desired results when tackling a similar conversion.

Most such failures he in the area of the product detector and agc. The installation of the filters is no problem; just follow the Collins directions. A Collins F455FB21 and X455KQ200 were mounted with their individual peaking components and the selectivity switch in a minibox. This assembly replaced the crystal filter and its output coil, which were removed. The mixer output coil was also removed, and B+ to the mixer plate was fed in parallel to the filter input coils through a 10 mH *rf* choke (Fig. 1).

The product detector and agc system did not prove as simple. There were a number of criteria which I had to consider in designing this circuitry for the 75A2. It was essential to have a high degree of overload tolerance, a very efficient product detector, and lots of audio to rectify for the agc. These characteristics, always desirable, are an absolute necessity in the 75A2. In this receiver, *rf* gain control is accomplished by varying the grid bias of the *rf* and *if* stages, as opposed to the more usual cathode bias control. The variable bias is tapped into the avc line through a resistive network which shunts the line and loads it rather heavily. In order to derive maximum benefit from the agc system, it is desirable to run the *rf* gain control as nearly wide open as possible at all times. Thus, plenty of agc voltage is required to prevent detector overload, and a high degree of overload tolerance is required of the detector.

Other criteria were my desire to stay with tubes rather than go solid state in this particular application, since I have had some unfortunate experiences with transistor circuitry "taking off" in the proximity of heat-producing tubes. In addition, good product detector action is more difficult to obtain with transistors than with tubes, though some of the new FET circuitry seems to hold the answer. Simplicity (less to go wrong), minimum number of tubes (less drain on the 75A2 power supply), and stable operation completed the list of requirements.

A number of product detector circuits were built, tried, and rejected. The double

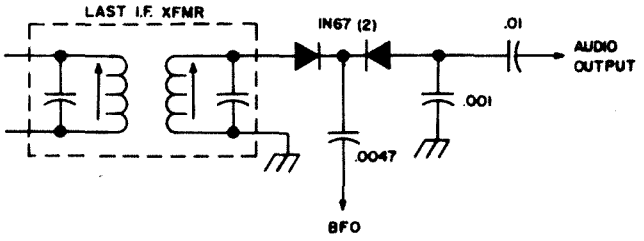


Fig. 2. A product detector having excellent characteristics can be simply installed in most receivers using two 1N67's in the above circuit. For use in the 75A2, however, this circuit did not provide sufficient output for adequate AGC action, even when amplified.

diode type (Fig. 2) using 1N67's back to back has excellent characteristics, but the output is too low to yield the kind of agc action required, even when amplified. Without exception, the triode circuits I tried fed through considerable 455 kHz bfo voltage, even when the output was filtered using tuned traps. Too much stray coupling between audio and *if* stages. The result was erratic agc action and bfo mixing in the *if* strip. Not good. In addition, triode and pentode circuits using cathode bfo injection were quite susceptible to overload. The low impedance presented by the cathode reduced bfo voltage enough to allow the *if* signal to over-ride the re-injected carrier.

Finally, the familiar 6BE6 circuit was chosen (Fig. 3). It out-performed the other circuits tried in practically every parameter. Output was at least as high as with any other circuit...higher than most. It offered by far the best overload characteristics, and remained linear and undistorted through an extremely wide dynamic range, resulting in natural-sounding, undistorted audio. It was duly incorporated into the 75A2. The .0039 μF ceramic by-passing the plate to ground reduces response above 3000 Hz and kills any 455 kHz energy at the output. The circuit is stable and uncritical. The only precaution which should be observed is to keep bfo energy out of the *if* strip. This point could be taken for granted, yet I know that many home-brew product detectors have failed to live up to expectations because the advantages of the circuit were cancelled by bfo mixing in the *if's*. Incidentally, don't neglect to realign the detector *if* transformer. Replacing the heavy load of the diode detector with the light load of the product detector makes quite a difference in the secondary tuning and Q.

With the product detector percolating nicely, I turned my efforts to the development of an equally satisfactory agc system. In my experiments with other product detectors, I had derived agc voltage by rectifying the output of either the detector itself, or its amplified signal, applying the resultant dc to the existing avc line through a 100K resistor. I tried both of these approaches with the 6BE6 and was not able to obtain sufficient voltage by rectifying its output direct, in spite of its high level. When I amplified the output and rectified it, the resulting dc potential was actually too high, but the voltage swing with modulation was still not great enough. Suddenly, the light dawned, and I

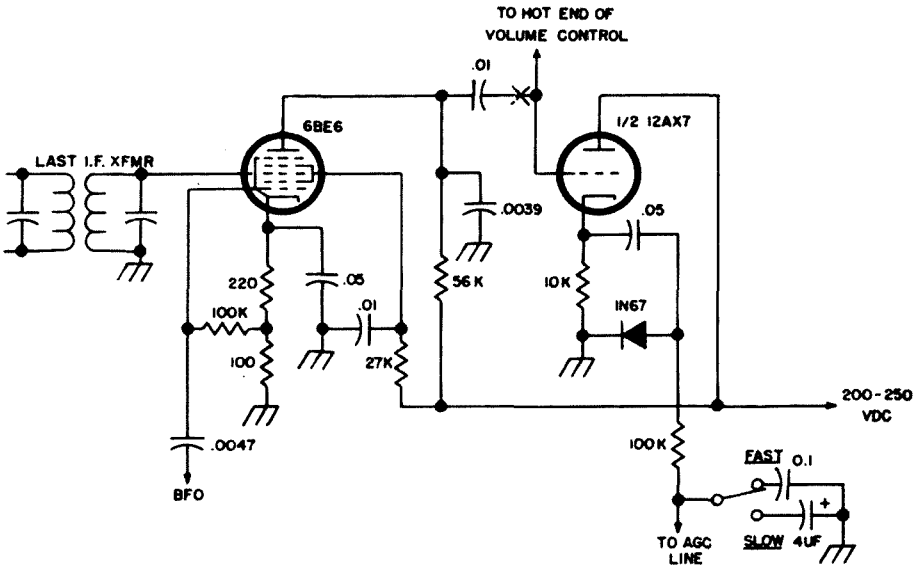


Fig. 3. Complete product detector and audio AGC system. Values of the capacitors switched by the "Fast-Slow" switch will vary from receiver to receiver. Cut and try is almost the only way to determine the value of the "Slow" capacitor. The "Fast" capacitor will ordinarily be the original capacitor shunting the AGC line in most receivers. Break at X to include the noise limiter circuit in Fig. 4.

realized that I had been overlooking the obvious impedance mismatch between ghe output of a tube and the low impedance of the diode rectifier. The cathode follower of Fig. 3 was quickly constructed and connected to the hot end of the volume control. A transformer hook-up was tried experimentally, but the cathode follower proved far superior in providing the desirable wide swing of agc voltage for a small variation in input to the detector. The unused 12AX7 triode was originally the avc amplifier in the Collins circuitry. I definitely recommend the cathode follower agc derivation as vastly superior to other methods commonly in use.

The 100K resistor was retained to avoid excessive loading of the agc rectifier. AGC action is so good that I only have to reduce the *rf* gain in the presence of strong local signals. The final touch is the variable time constant. In the CW position, only the original .1 μF capacitor shunts the agc line; switching to the SSB position adds a 4 μF miniature electrolytic, and increases the discharge time to about .6 seconds. The attack is only softened slightly...just enough to prevent the overshoot "click" at the beginning of a transmission or after a pause. Other receivers will require much smaller values of capacitance if their agc lines are less heavily loaded than that of the 75A2.

So far so good. Now for the noise limiter. Not so good. Every conceivable type of noise limiter circuit was tried. At first, I considered a noise blanker, but the cumbersome circuitry, space and power requirements discouraged this approach. I then turned to simpler possibilities. Using fast time constant agc voltage to an early *if* stage did not prove as satisfactory for me as it apparently has for at least one commercial manufacturer. Most series and shunt clippers using diodes created audio distortion to a degree which I found objectionable when they were adjusted for satisfactory limiting. In addition, they did not provide the advantage of limiting ahead of selective circuits, which is so desirable. *RF* and *if* clipping proved only marginally effective. I searched the manuals and magazines, but never found a circuit which surpassed the one shown in Fig. 4. It causes some audio distortion, but it is bearable, and limiting is sufficient under most conditions.

The diodes are biased by contact potential, and peaks exceeding it are shorted to ground through the appropriate diode. Silicon and germanium diodes were tried, but

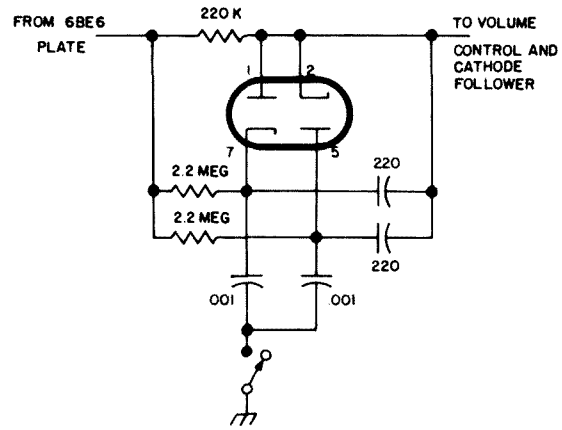


Fig. 4. The noise limiter. Audio distortion becomes objectionable on strong signals, so the limiter should be switched on only when needed. This circuit is at its best on weak signals, which can be copied even through heavy QRM. An i-f noise-blanker would be much better, but space and power considerations required a compromise. It's far from the ultimate, but it works better than most circuits and is at least as good as any other tried.

seemed to cause more distortion than the 6AL5 because of their greater sensitivity. This can be adjusted, but the 6AL5 was there, so I used it. The 220 pF capacitors suppress dc spikes, which are troublesome at high clippink levels and relieve some of the harmonic distortion generated by the clipping action. This clipper definitely cannot be left in the circuit at all times. It should be used only when needed, since strong signals will be clipped and distorted. It is especially useful when hunting through QRN and atmospheric rubbish for weak signals.

The addition of a 5:1 reduction drive and oversized tuning knob completed the first phase of my 75A2 conversion. It's almost overload proof. AM reception is possible, though definitely inferior to diode detection. The product detector–agc system is at least the equal of anything in current commercial usage, and a great deal better than some. All in all, I don't feel I could be better off with a brand new receiver. And that's the beauty of home brewing. I get something for less than it would have cost off the shelf, learned a few things in the process, and got a real feeling of satisfaction out of making it work.

What's next? A 6 meter conversion of the old 11 meter band, continued efforts to develop a satisfactory noise limiter, and a Q multiplier rejection filter built right into the 75A2, of course!

W8RHR

LEARNING FROM EMERGENCIES

Experience is the best teacher, obviously, so it is possible that much can be learned from the problems that arose during the February 1971 Los Angeles earthquake. The Los Angeles SCM has published an interesting and lengthy report on the effort, and I believe that the conclusions he reached will be of value to every club and individual concerned with providing emergency amateur radio communications.

Disaster Preparation

Operators for a particular Emergency Operating Center should be recruited from a diverse physical area. The W6IN Society had many regular members unable to assist as they were personally involved in attempts to provide solely for their immediate families. There is a need for the individual radio amateur to be well prepared as well as the emergency oriented groups in which he participates. He must have his own family cared for in order that he can even be available in time of disaster.

Radio amateurs should establish an emergency kit or list of required items to take on an emergency operation. This kit should contain sufficient items to provide food, clothes, spare parts, etc., which might be needed to render a man self-sustaining for 72 hours in the field.

The telephone tree (one individual calling a list of persons who in turn call an established list on the telephone) usually is excellent for exercises and drills, but it proved useless within this disaster area. There was no telephone service. An activation system involving persons reporting to a gathering frequency or a specific location is to be preferred.

Emergency power and equipment must be tested regularly at definite intervals and for substantial periods to insure its being in suitable operating condition. The Emergency Operating Center generator that failed had been tested weekly on Mondays for fifteen minutes, but had never been run for any substantial period of time. The fuel pump quit, it lacked sufficient radiator water (water mains were broken by the quake), and the fuel supply was low.

Should an Emergency Operating Center become unusable it is vital that some provision be made for a portable command post (preferably a mobile command post) with either permanent equipment installed or provisions made for equipment. A mobile command post should not be stored at the same point as the Emergency Operating Center or both may be lost at the same time.

Contacts established with local business firms, concerning the use of necessary equipment accessories and supplies in time of disaster or need, will prove extremely beneficial.

It must be remembered that amateurs are supporting local government disaster efforts as communicators and are not responsible for much of the planning, securing of goods and administrative decisions. Also a single unpleasant confrontation with a city official can change the image presented by the entire operation.

The role assumed in this effort unfortunately encompassed more than that of a communicator to the extent of becoming an administrator in a decision-making position. In retrospect this is undesirable and undermining to the general efforts of amateur radio to establish better working relations with public administrative agencies.

It is also noted that it is highly desirable to have available to the proper administrative decision-makers the ability to monitor other services (hospital, police, fire, etc.) at the Emergency Operating Center.

A professional appearance of the radio amateurs making contact with disaster officials is highly recommended. This would include proper dress and the presence of mature attitudes.

Overall communications coordination efforts with other amateur radio groups hoping to provide some service in the disaster area is vital. Groups of well-intending amateurs – unless recognized by the coordinating disaster group officials – can defeat the overall effort. Individual radio amateurs should be affiliated with a well-disciplined emergency group prior to a disaster if they expect to be fully productive during a disaster. Amateur radio groups operating in such a situation must have good communications horizontally among those in charge during the disaster situation.

A universally recognized insignia, picture ID card should be established for those with a purpose in a disaster area. Any such ID must also be made clear to proper authorities engaged in the disaster operations.

During the Disaster

To "be prepared" is insufficient. Established communications groups must volunteer their services to

affected areas. Without such volunteering W6IN, for example, would have been hard-pressed to provide adequate communications to the City of San Fernando on an emergency basis.

Shifts for communications personnel should be established as rapidly as feasible for continuity and efficiency.

A quartermaster of radio gear, accessories and other equipment to be used during operations is necessary to coordinate their issuance. Some personal radio equipment was "lost" through inadequate control.

Some panic information was disseminated to the public by the news media pointing up the necessity for strict control over any media releases. Speculation and rumors should be discouraged on amateur radio bands as well.

Comments and Conclusions on Health and Welfare Messages

When mail took a significant time to cross the country and long distance calls cost considerable sums, amateurs performed a real service by relaying messages that were mailed for final delivery. The attitude of many amateurs regarding mailing of traffic today can be summed up by one comment :

"When offering to send a message without a phone number to a person with either an unlisted number or a number listed under another last name, the originating station would be well advised to provide the originating party with a free post card rather than essentially offer one at the expense of stations in the delivery area."

Individuals make long, futile efforts to locate numbers. Some attempt to ditch the stuff on someone else, possibly a mile or two closer, although the addressee would be a local call for the first station if a phone number were available. Also it is difficult to get a letter into the postal system at a point where delivery will be prompt. (A card put into the mailbox after the last pickup of the day stands little hope of next-day delivery.) With the present air mail handling of first class mail, any radio message eventually mailed will probably reach its destination later than had it been mailed at the source.

Many of the instant service nets have resorted to not taking traffic listings without telephone numbers and liaison with them is sometimes necessary for the older, basic traffic nets. Especially in a disaster, the delivery stations are sufficiently overloaded with traffic to be justifiably annoyed at having to devote large efforts to researching telephone numbers. Inclusion of telephone numbers on messages cannot be overemphasized.

Additionally it is suggested that the National Traffic System, the three Area Staffs and the ARRL's Communications Manager should establish special provisions for handling large volumes of traffic in disaster situations that can be activated readily. There has been no indication of any special, organized efforts on a large scale within NTS to accommodate the large traffic volume occurring only days after a national exercise in emergency preparedness in the form of the ARRL's Simulated Emergency Test, "SET." Along the same lines more emphasis is needed on faster routing and delivery of traffic in NTS (traffic originating in NTS after the quake typically took three or four days to reach California NTS circuits). In addition to simplified routing techniques the use of simplified message forms (as used on the instant service nets) should be objectively investigated for use in disasters as well as increased use of modes other than CW.

Inquiries into Disaster Areas

Most reports on disaster operations conclude with the thought that inquiries should not be sent into disaster areas. The previous paragraphs are evidence that these efforts have not exactly been heeded. In a disaster where 65 people died out of a population of over 7 million, it could be seen that the answer to "Are you OK?" was "Yes." If there was any need for help, no doubt the affected parties would have requested help. However, the enhancement of the radio amateur's image was felt by the participants to have justified the effort.

Two types of inquiries somewhat amazed a few amateurs. One was an inquiry addressed to a person at an "unknown veterans' hospital in or near Los Angeles." In other words, the originators were so concerned about Uncle Charlie they were glad to take advantage of free services to inquire about his state, but not quite interested enough prior to the disaster to even know where he lived.

The other was a public service group that originated all their health and welfare traffic with the organization's signature rather than the originating party. Delivering amateurs felt somewhat embarrassed at receiving comments like "What is this all about?" when delivering "Are you OK? From the XYZ County, East Coast State Emergency Helpers Organization" message to a person living fifty miles from the quake center.

Overall Conclusions and Comments

It is noted that all disaster communications were handled by voice. With the exception of the Southern California Net on CW and the Navy MARS RTTY circuit, the health and welfare message load was handled by voice. CW, albeit more efficient for exchange of message traffic between experienced operators is a skill that has not been developed by enough amateurs to result in an effective disaster service. Complaints were voiced by Southern California Net members about lack of coverage in many areas which resulted in many messages being delayed even more.

The ease of training operators, reorienting an operation (setting up separate frequencies for different areas, for instance) and making large numbers of people aware of what's happening and capable of helping, makes voice by far the more effective means of disaster communication.

The Future

While it was a learning situation for Los Angeles AREC, this disaster communications operation demonstrated the value and merit of AREC. Several steps are being taken to improve and develop AREC in the Los Angeles Section under the leadership of the Section Emergency Coordinator, WA6QZY. FM has been clearly demonstrated to be a highly effective form of mobile and emergency communication for which reason 146.82 MHz FM simplex has been designated as the section-wide AREC emergency and mobile frequency in the Los Angeles Section.

Through the cooperation of the Edgewood Amateur Radio Society, Inc., the W6FNO repeater will repeat 146.82 MHz to 146.70 MHz. Also the Palisades Amateur Radio Club of Culver City has made their repeater, WB6ZDI, available to Culver City AREC (146.61 MHz in, 147.33 MHz out FM). Hopefully other radio clubs will also provide such support of AREC. 14302 kHz has been designated as the section's health and welfare frequency. A command channel on 2 meter FM for ECs, SEC, SCM and their assistants is being developed as is a high frequency band frequency for use as a gathering point. Discussion is also being given to an information station which would be used on a regular basis as an Official Bulletin Station.

Bill Hoisington K1CLL
Far Over Farm
Peterborough, N.H.

Solid State Tuneable IF

Fixed-Tuned, 1.65 MHz IF Companion Unit to 28–30 MHz IF in January, 1970 issue of 73

This is the detailed low-down on the construction of some practical i-f stages for amateurs, including windings, cup-cores, etc,. for 1.65 MHz, employing techniques you can use on other frequencies as well.

There are several 455 kHz i-f strips on the market which work quite well, however these are a compromise in the trade-off on low image versus selectivity. The easiest way for the home-brewer to be sure to obtain narrow-band selectivity at low cost and in battery-portable form is to use a low i-f frequency. This means image trouble unless more conversions are used. If this is done both freedom from image *and* selectivity result. And if you tap into the outputs of both i-f's you can have an instant choice of broad or narrow bandwidth on a switch. The business of crystal filters is left to the professionals, resulting in receivers in the hundreds of $.

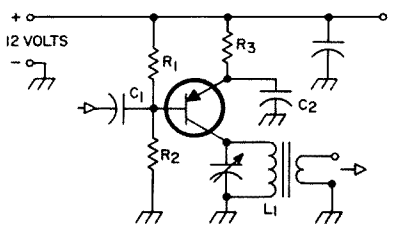


Fig. 1. Schematic of the fixed-tuned first stage.

DC Collector Voltage at the Ground Level

This is definitely good. Fig. 1 shows the simplicity of the first stage, which is fixed-tuned. What could be simpler? And it works very well. One coupling capacitor to the base, one bypass capacitor for the emitter, and that's it. All coils have one side grounded to the copper-clad baseboard.

Base Resistors

A number of tests were run on these items, which were found to be non-critical, as long as the ratio is held to furnish the needed base turn-on voltage. Values from 5K down to 250 ohms were tried for R1 (Fig. 1). At 250 ohms the shunt resistance across the base began to lower the gain. Naturally R2 has to be changed for every change in R1. A ratio of between four to one and six to one is good. I settled for 2.2K for R1 and 12.5 for R2, but this ratio may change a little for other transistors.

Input Tuning Not Required

This also was tested carefully. The output of the mixer from which the 1.65 MHz i-f was derived is already tuned, so it is really a question of how many tuned circuits you want to use. Various arrangements of tuned base coils were tried, with little increase in gain noted, so tuned circuits were left out of the input.

Interstage Coils

A number of different types of i-f transformers were wound and tested, with different iron cores, the matter of size entering here to a considerable extent because there will be a number of stages and also a hand-carried rig has to be kept as small as possible.

You can get real fancy here in the matter of i-f transformers, and wind them up with Litz wire, original German "Litzendraht," which is made up of many strands of small size enamel wire, example, "5/40." This is 5 strands of no. 40 enamel wire, and *below* about 7 MHz it does increase the Q to any remarkable extent. To match the benefits of this wire you can use fancy cup cores of powdered iron from Holland, and end up with a Q of 300 to 400 around 455 kHz. But, and it's a big but, you can't hold it!

The necessary air gap changes, and temperature, moisture, etc., put in their two cents worth also.

So, in one sense, it is better, at least more permanent and easier for the home-brewer to use more stages each with a lower Q and greater stability. For the narrow-band section we will work on this question a little. One more tuned circuit, with another stage allows all of them to run with conservatively longer life, practically no heating, no feedback, and is much better if you want a little more selectivity.

That problem has already been solved here by having the choice of two bandwidths.

Threaded Core IF's

Refer to Fig. 2 for these items. When you random wind by hand, which is pretty easy and works all right, wind on 25 turns first, then one pi of 50 and then the other, as shown in Fig. 2. These separate pi windings increase the Q quite a bit, helping with random winding which does not have the best of Q ordinarily.

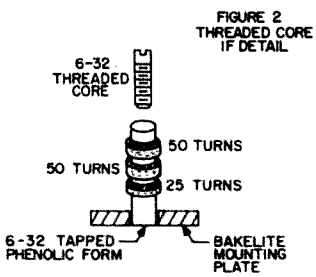


FIGURE 2
THREADED CORE IF DETAIL

Inserting the 6/32" iron core from the top keeps it in the main body of the winding for Q and coupling, and then reaching into the 25 turn part, serves to tune a little above and below the desired frequency for trimming, which is always needed.

As mentioned, you can make coils this way, or get real fancy. That's up to you. L2 is wound in the low place between the two fifty turn windings. L2 is generally a small number of turns, say from 2 to 5 turns. See final schematic and coil table.

What Not to Do

With three tuned circuits on 1.6 MHz, one in the 28 to 30 mhz mixer collector output, and one in each of the two i-f stages being detailed, it seemed only natural to try and achieve more Q with bigger and better powdered iron cores. Having a large selection of these, from some real small ones like 1/32" diameter O.D., up to the 1/2" loopstick sections, which same can be cut with a file, I wound up some 1.6 MHz coils with various turn numbers from 50 to 100. Well, the Q went up, but so did the troubles! The most nasty kind of feedback you ever saw crept in and then settled down to stay! And I couldn't neutralize it.

To cut it short, it was magnetic feedback, from the collector coil to the base winding on the previous collector coil, as I found out finally by removing the first stage and checking with just one transistor running. It oscillated all right, whenever the base coil was within several inches of the collector coil. Industrial designers (technicians) in large receiver companies can well laugh, someone else is paying for *their* days! Even though these windings were separated by more than three inches, trouble still occurred.

At last I remembered building a 16 to 18 kHz sideband filter some years ago (it worked good by the way) where I had to use tinned iron shield cans to keep down the magnetic coupling. It all came back to me then.

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The Answer

The solution for compact units is to enclose the *outside* of the winding with powdered iron as well as having a center core. This causes the magnetic field to curve back in a sense, into the coil again, instead of travelling through the "near field" over to the base coil winding, where you most decidedly do not want it.

These kind of cores are known as cup cores, and there are millions available practically for free. Most of the i-f transformers made for *tube* i-f's have some beauties in them. Actually, two each. One is illustrated in Fig. 3A., with the winding I used, in Fig. 3B. I just happen to have (did I mention my 45 foot junk box?) a lot of these because of some ten years of work with sub-miniature battery tubes, like the 1V6, 1AD4, etc. So, you take the insides right out of one of these transformers, like a Miller no. 10C, and there are the two cup cores which are good for at least 455 khz up to several mhz.



Fig. 3. A. Cup core and B. winding for 1.65 mhz i-f.

They do a swell job on 1.65 mhz, with plenty of gain, no neutralization needed (so far) and, using 500 pf or more tuning, the variations in collector capacity with current on avc action can be eliminated.

The use of a large C also drops the impedance down for a better match with the transistor collectors.

A completely enclosed cup core in one i-f stage with a cover over the top, shown open in Fig. 3A, can be used very close to another stage without feedback, due to the greatly lessened external magnetic coupling. When you go in for real compact assemblies you will have to watch out for the electrical coupling (by capacity). Toroid coils are

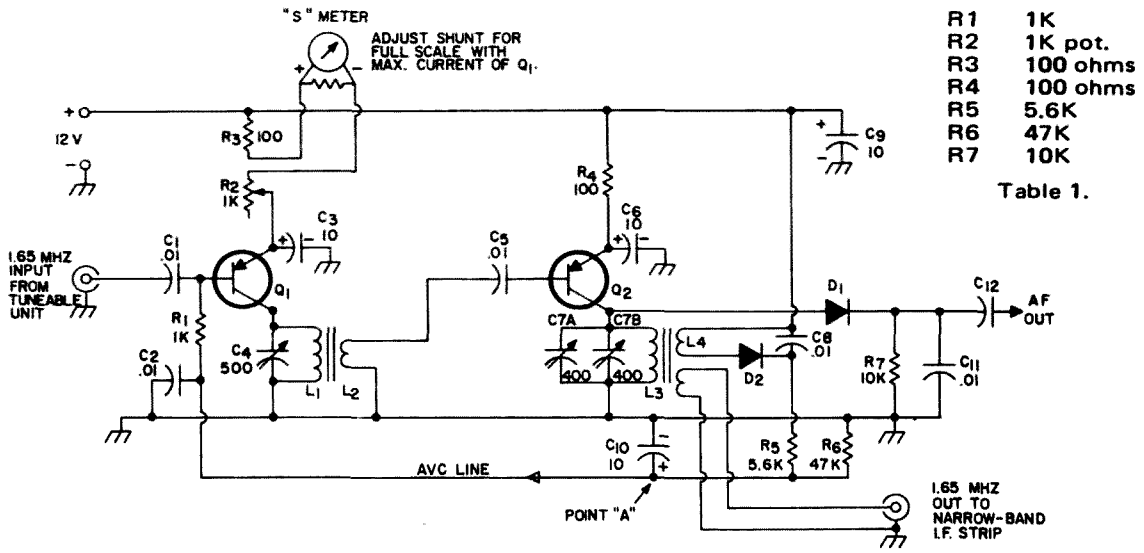


Fig. 5. Final schematic.

often used for this purpose but they run into money and are much harder to wind.

A Special, Simplified AVC

For some time now I have not been completely satisfied with the avc system found in most books for economical type circuits, which I have often used myself. This one is shown in Fig. 4.

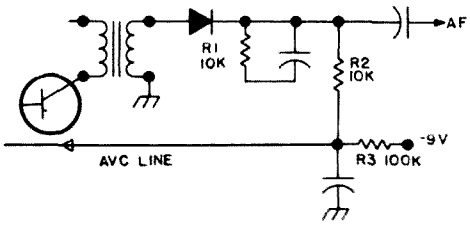


Fig. 4. "Old" avc circuit to be avoided.

R2 and R3 tend to load the diode with dc when you adjust them for best operation of the controlled stage, resulting in af distortion at certain levels of signal. As noted in Fig. 4., do *not* use the circuit shown there. Use the one shown in Fig. 5, the final and complete schematic, which has the new simplified circuit. It still does not use an additional transistor, but it does isolate the af from the avc action and produces beautiful af, by using two diodes.

D1 is a regular amplitude demodulator used solely for af. A secondary winding and D2 generate the dc voltage for the avc line.

In the absence of a signal, point A sits at about one volt negative from the plus 12 volt bus, resulting from the combination of D2, R1, and R2, and the negative bus which is also the ground plane in this i-f unit. This causes Q1 to operate at normal gain with a few milliamps of current.

An incoming i-f signal will build up a dc voltage through D1 making point A go through zero volts and, on a very strong signal up to around 2 volts positive with respect to the 12 volt bus. This of course automatically reduces the curent and gain of the avc controlled first i-f stage.

R1 and R2 can now be juggled for the best avc action with no effect at all on the af demodulation.

Completed Circuit

As mentioned, Fig. 5 shows the final schematic which operated in an excellent fashion with the 28 to 30 MHz tuneable section. The use of this tuneable i-f section allows the assembly of hand-carried battery portable rigs using crystal control all the way from the transmitter through to the local oscillators. The bandwidth of this fixed i-f on 1.65 MHz is about 50 to 100 kHz, depending on signal strength, and makes an excellent unit for search, tune-up, and medium distance reception with various front ends, antennas, converters, etc., on 432, 1296, and 2400 MHz. This amount of bandwidth allows your converter local oscillator crystal as well as the transmitter crystal of the lad on the other end of the QSO to "move" a little (they will!).

. . . K1CLL

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Saint Peters MO 63376

CHECKING ZENER DIODES

Over the past several years the cost of producing ultrapure silicon and the resultant devices has decreased at an extremely rapid rate. This reduction has been reflected in the cost of all silicon semiconductors. Perhaps the area in which the change has been most noticeable is in bipolar transistors, but at the same time the same reductions have been made in zener diodes too. Almost monthly one magazine or another features an article on the subject of testing and grading the "10 for" or "100 for" type of transistor. The subject of putting surplus zener diodes to use has not been popular and perhaps for this reason the price of unmarked zeners is extremely low. One large mail order house currently lists an assortment of 20 for less than $2. What then is needed to test and categorize these diodes? Fortunately the procedure and the equipment are simple.

First of all we must supply a voltage in excess of the zener point of the diode under test. This may be a special power supply built for the purpose or voltage may be taken from a bench supply or stolen from other equipment. We must also limit the current through the diode to a safe value in order not to exceed the dissipation rating of the device.

The diagram shows the simple setup in use at this QTH. The fixed resistor serves a current limiting function only. The voltmeter, which may be any VOM, VTVM, or panel meter, measures the drop across the zener. The potentiometer acts as a voltage divider and allows the voltage applied to the diode to be varied above and below the regulating point. If you are fortunate enough to have a bench supply available, the internal variable feature may be used and the potentiometer eliminated.

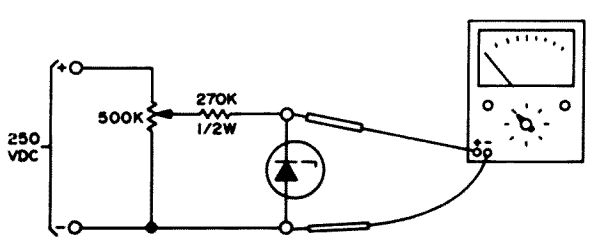


Fig. 1.

The constants given were chosen with an eye to minimum dissipation within the diode. The maximum current is limited to 1 mA, making this setup usable for a wide range of diodes types and sizes. Other constants may be selected if only higher power types are to be checked.

In use, the unknown diode is connected across the terminals with the indicated polarity. (Use trial and error if the diode is completely unmarked.) Always start with the potentiometer at the low voltage position and slowly increase the applied voltage until there is little or no increase in meter reading with increase in voltage. This is a rather abrupt indication. You will have no trouble detecting it. This is the voltage at which the diode will regulate. As they are checked, mark each diode with the correct voltage. A scrap of masking tape is a simple way of doing this.

A shorted diode will give no meter reading at any voltage – an open diode will allow the meter to read the supply voltage.

There remains one fly in the ointment. You will have to learn by experience the dissipation ratings of the various physical sizes of diodes. A short look at the actual size pictures in parts catalogs will be a good start.

. . .WAØABI

GENERAL CLASS LICENSE STUDY GUIDE

Questions & Answers Part II

27. Define Ohm's Law. How does it relate to resistive and reactive impedance?

Ohm's Law states that the potential across an impedance, in volts, is equal to the product of current through the impedance, in amperes, and the impedance itself, in ohms. Stated algebraically, E = IR. Ohm's Law applies to any impedance, whether resistive, reactive, or a combination of the two. When dealing with ac, however, rms values for voltage and current must be used, and when dealing with a mixture of resistive and reactive impedance, appropriate complex-number arithmetic is necessary. (General course, Part I)

28. Describe ways of equalizing the reverse voltage drops across series connected silicon diodes.

To equalize reverse dc voltages across series-connected silicon diodes, moderately high valued resistors should be connected in parallel with each diode. 470,000 ohms is a typical value. This is enough smaller than the reverse resistance of the diode itself to equalize the voltage, yet large enough not to degrade the diode action. To equalize ac voltage spikes, low-value (.001 μF) capacitors should be connected in parallel with each diode. In many cases, both the resistors and capacitors are used. (General course, part VII)

29. What is the maximum legal dc power that can be delivered to the final amplifier of an amateur transmitter? How is this power determined?

The power applied to the final stage of an amateur transmitter cannot exceed 1000W (on some bands, 50W), as measured from the voltage and current at the dc input to the final stage. If power exceeds 900W, accurate means of measurement must be provided. (General course, part VIII)

30. Define instantaneous power, average power, sideband power, audio power, and peak envelope power. How is each related to the voltage and current that produced it? How is each related to the unmodulated carrier power?

Instantaneous power is the product of instantaneous voltage and instantaneous current, all taken at the same instance. It is a fictional concept; current exists only in relation to time, so that "instantaneous current" cannot be defined. Instantaneous power is, however, a useful concept, in that it is the highest power level likely to be encountered in a circuit.

Sideband power is the difference between average envelope power and unmodulated carrier power, and is not normally determined on the basis of voltage and current.

Audio power is the audio-frequency power produced by a modulator, and is the product of rms audio voltage and rms audio current. This is very close in value to sideband power, for a high-level-modulated AM transmitter, differing only by losses introduced in the modulated amplifier.

Peak envelope power is the product of

peak envelope voltage and peak envelope current, both measured at radio frequency.

Average power of a 100% modulated AM signal is 1.5 times the unmodulated carrier power. Sideband power is half the unmodulated carrier power, as is audio power required for 100% modulation. Peak envelope power is 4 times unmodulated carrier power. Instantaneous power may be any value between 0 and peak envelope power, depending upon the instant chosen. (General course, part III)

31. What is meant by the bandwidth of a signal? Compare the maximum necessary bandwidth occupied by a CW signal, an SSB signal, a double sideband signal, and an ordinary voice signal.

The bandwidth of a signal is the measure of the amount of rf spectrum space occuped by that signal, and is the difference (in hertz) between the highest frequency component of the signal and the lowest frequency component. Assuming a band-limited modulating signal in which no component is higher than 3 kHz for all voice signals, an SSB signal will require 3 kHz bandwidth, while both double sideband and ordinary AM voice require 6 kHz. Bandwidth required by a CW signal depends upon the transmission speed in wpm. Very slow transmissions (1 wpm or so) may use as little as 1 Hz bandwidth. Normal CW requires approximately 50 Hz. High-speed CW may require as much as 250 Hz. (General course, part IX)

32. What is neutralization and how does it contribute to proper amplifier operation? What procedure should be followed to properly neutralize an rf amplifier?

Neutralization is the process of canceling out all undesired feedback from an amplifier, and contributes to proper operation by preventing regeneration and self-oscillation of the amplifier. One method of properly neutralizing an amplifier is to disconnect all plate and screen voltages, leaving grid bias and heater voltages in place, and then applying normal input signal to the circuit while monitoring the output circuit with a sensitive rf indicator. The neutralization adjustments are then moved through their range until no feed-through of energy can be detected. This is the point of correct neutralization. (General course, part VIII)

33. What are the distinguishing features between series-tuned and parallel-tuned resonant circuits? How is the resonant frequency determined? Define the "Q" of a resonant circuit.

In a series-resonant circuit, the opposite-value reactances are in series with each other, making total circuit impedance equal to only the resistive component of the tuning components. Impedance is thus low at resonance, and current is high. In a parallel-resonant circuit, the opposite-value reactances are in parallel with each other, and the current circulates within this parallel circuit, making external current low and impedance high at resonance. The resonant frequency is that at which the reactances are equal, for series tuned and high-Q parallel tuned circuits. For low-Q parallel tuned circuits, several different frequencies of "resonance" are defined and the choice depends upon the particular application. The "Q" of the circuit is the ratio of energy stored to energy released per cycle, or roughly, the ratio of reactance to resistance. (General course, part IIB)

34. How does an ac power supply produce a dc voltage? Distinguish between a choke-input and a capacitor-input filter and compare their operating characteristics. What is dynamic regulation and how can it be improved? How do the output voltages of a full-wave center-tapped and a full-wave bridge rectifier compare?

An ac power supply produces dc output by means of rectification, a valving action in diodes which permits current to flow more readily in one direction than in the other.

A choke-input filter contains inductance as its first reactive component, while a capacitor-input filter has as its first reactance capacitance. The choke-input filter provides better voltage regulation with variations in load than does the capacitor-input filter, but produces less output voltage under light load conditions. The capacitor-input filter produces higher output voltage, but puts more strain on the recti-

fiers and transformer of the power supply.

Dynamic regulation refers to changes in power supply output level caused by changes in load current. It can be improved by providing additional energy storage (bigger capacitors) in the power supply's output circuit, or by reducing the power supply source impedance by any other means such as electronic regulation.

For the same transformer, the full-wave bridge rectifier produces twice the dc output voltage of the full-wave center-tapped rectifier circuit, because the end-to-end voltage capacity rather than the end-to-centertap capability of the transformer is used. Not all transformers will withstand the high voltage which appears at the centertap under the bridge connection, however. (General course, part VII)

35. How do resistors combine in parallel and in series to give total resistance? Capacitors? Inductors?

Resistors in series produce a total resistance equal to the sum of the individual values of each resistor in the chain. Inductors add inductance in similar fashion, if mutual coupling is excluded. Capacitors in parallel also accumulate value to the sum of the individual values.

Resistors in parallel, capacitors in series, and inductors (without mutual coupling) in parallel divide the current in such a manner as to produce a total value smaller than any individual value. The total is the reciprocal of the sum of the reciprocals of the individual values. (General course, part I)

36. How does voltage division occur across series-connected resistors? Capacitors? Inductors?

Across series-connected resistors, an applied voltage will divide proportionately to the values of the resistors, with the highest-value resistor developing the greatest voltage across it. The same is true of capacitors and of inductors, so long as the applied voltage is ac. The division in this case is proportional to the reactance of each component rather than the resistance. (General course, part I)

37. What does it mean to connect circuit elements in series? In parallel?

When circuit elements are connected in series, the same current flows through every element in the circuit. When elements are connected in parallel, current flowing through one element does not flow through any other element, but the same voltage appears across every element in the circuit. (General course, part I)

38. What is inductive reactance? Capacitive reactance? How is their value determined? How do like reactances combine in series? In parallel?

Inductive reactance is a measure of the degree by which the voltage in a circuit is retarded in phase with respect to the current. Capacitive reactance is a measure of the degree by which current is retarded relative to voltage. Inductive reactance is calculated from the formula $X_L = 2 \pi f L$, and capactive reactance from the formula $X_C = 1/(2 \pi f C)$. Like reactances combine in series and in parallel just as do resistances. (General course, part II)

39. Describe the transmission characteristics of the amateur bands below 30 Mc/s (MHz). List several propagation factors that influence signal transmission and reception in these bands.

Noise, both natural and manmade, and ionospheric conditions, which depend upon many factors, both strongly influence transmission and reception in all bands below 30 MHz.

1.8 MHz: Only groundwave useful during day. Range at night limited to only a few thousand miles, and that only when band is at its best. Noise usually high both day and night.

3.5 MHz: Noise high both day and night, especially in summer. Ground wave and very short range skip (200 miles or so) useful during day. At night may reach worldwide range but usually limited to one hemisphere.

7.0 MHz: Noise not so severe as on lower bands. Similar to 3.5 MHz during day but with somewhat greater range. At night, worldwide coverage possible and good coverage of hemisphere usual.

14 MHz: Very little noise except during

solar storms. Long range both day and night. Coast-to-coast skip during day, worldwide at night as usual matter.

21 MHz: Like 14 MHz, but band not usually open during sunspot minima. At its best, worldwide coverage during daylight.

28 MHz: Worldwide coverage for 2 years out of 12, useful primarily for local work rest of time. MUF usually too low for this band, but worldwide daytime DX possible when conditions are at their best.

(General course, part XII)

40. List the basic stages of a conventional superheterodyne receiver and tell what function each stage performs.

The rf amplifier stage isolates the mixer stage from the antenna, reducing unwanted radiation. The mixer stage converts the incoming signal to the fixed intermediate frequency. The first (or local) oscillator provides a signal to the mixer which selects the desired incoming signal. The i-f amplifier stage amplifies the signal, and provides selectivity. The second detector converts the signal from intermediate frequency to audio frequency, using the output of the beat frequency oscillator if necessary (for CW and SSB reception). The audio stages then amplify the detected signal to the desired amplitude to drive headphones or a speaker. (General course, part X)

41. How is the approximate length of a half-wave dipole related to its resonant frequency? Compare the operating characteristics of a half-wave dipole and a grounded antenna.

The length of a half-wave dipole antenna is approximately equal to 468/(resonant frequency in MHz) feet.

The half-wave dipole is electrically balanced; the grounded antenna is not. Feed impedance of a half-wave dipole in free space is 73Ω; that of a grounded antenna is approximately 35Ω. The half-wave dipole has a directional pattern, with nulls off the ends of the wire; the grounded antenna is omnidirectional. The half-wave dipole produces high-angle radiation; the grounded antenna's radiation is concentrated at low vertical angles. In general, the half-wave dipole provides better short and moderate range coverage, while the grounded antenna provides greater range for DX. (General course, part XI)

42. What do high- and low-pass constant-k filter circuits using balanced and unbalanced π-and T-sections look like?

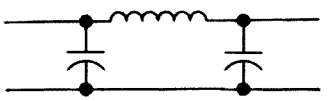


Fig. 1. Constant-K unbalanced π-section low-pass filter.

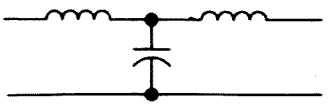


Fig. 2. Constant-K unbalanced T-section low-pass filter.

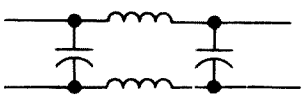


Fig. 3. Constant-K balanced π-section low-pass filter.

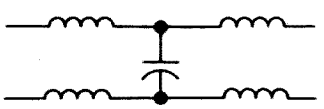


Fig. 4. Constant-K balanced T-section low-pass filter.

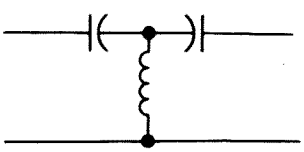


Fig. 5. Constant-K unbalanced T-section high-pass filter.

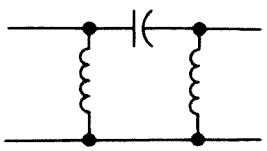


Fig. 6. Constant-K unbalanced π-section high-pass filter.

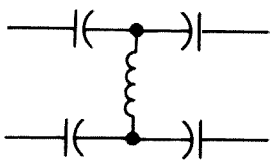


Fig. 7. Constant-K balanced T-section high-pass filter.

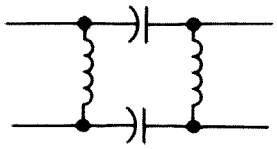


Fig. 8. Constant-K balanced π-section high-pass filter.

43. How can amateur equipment be protected from lightning discharge?

By means of a grounding switch. (General course, part XI)

44. What are the basic stages of a single sideband (SSB) receiver and transmitter and what purpose does each serve?

Basic stages of an SSB receiver are the first mixer, first oscillator, if strip, second mixer, second oscillator, and audio sections. The first mixer converts the incoming SSB signal to an SSB signal at intermediate frequency, by means of the output of the first oscillator. The i-f strip amplifies this signal, and provides the necessary selectivity. The second mixer (sometimes called a product detector) uses the output of the second oscillator to demodulate the SSB signal into audio, which is then amplified by the audio section.

Basic stages of an SSB transmitter are the SSB generator, the frequency determining circuits, and linear amplifiers. Within the SSB generator are included audio circuits and mixers, to generate an SSB signal at fixed frequency. This fixed frequency SSB signal is then mixed with a variable frequency signal to produce the final output signal, which is then amplified by linear amplifiers.

The transmitter and receiver are almost exact inverses of each other, which has led to the development of transceivers which share common stages between transmitter and receiver functions. (General course, part X)

45. List the three main classes of amplifier operation and explain the use for which each class is best suited.

The three main classes are A, B, and C. Class A amplifiers are best suited when low distortion is required, as for receivers and hi-fi amplifiers. Class B amplifiers provide higher efficiency and are best suited for use in portable and mobile equipment where long battery life is essential. Class C amplifiers are best suited for high-power rf amplifier application where their distortion can be tolerated. (General course, part VI)

46. What are "images" in a receiver?

Images are spurious responses in a superheterodyne receiver caused by the presence of an unwanted signal on the "wrong side" of the local-oscillator signal. If the receiver is designed to make use of the "input-minus-local-oscillator" difference frequency as its i-f, the "local-oscillator-minus-input" difference frequency is an "image." (General course, part X)

47. What is meant by "flat-topping" of a single sideband signal and what are some possible causes of it?

Flat-topping is a form of distortion in which the output signal's peaks are flattened rather than being reproduced accurately. It may be caused by excessive level of input signal, or by incorrect bias or loading in the amplifier stage. (General course, part VI)

48. What does grid current flow in a class A amplifier indicate?

In most class A amplifiers, grid current flow indicates incorrect operating conditions. The usual cause is severe overdriving of the input. It may also be caused by a failure of grid bias voltage. (General course, part VI)

49. Briefly discuss how a multiband "trap" antenna operates.

A multiband trap antenna includes parallel-resonant tuned circuits at critically spaced points in an otherwise normal half-wave dipole. At the frequency at which the trap circuit is resonant, the tuned circuits act as insulators and disconnect the ends of the antenna, so that the inner portion of the antenna acts as a half-wave dipole at

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this frequency. At lower frequencies, the net reactance of the trap circuits is inductive, and so the traps act as loading coils to electrically lengthen the wire. The full length of the wire (as electrically lengthened) then acts as a half-wave dipole at the lower frequency. By adding additional pairs of trap circuits, and by proper adjustment, the antenna can be made to cover all amateur HF bands. (General course, part XI)

50. How can the power input to the final amplifier of an SSB transmitter be determined?

The power input to the final stage of an SSB transmitter is determined by measuring plate voltage and plate current with dc meters having a time constant of at least ¼ second, and using the highest values indicated by the meters under normal modulation. (General course, part VIII)

51. Compare the operating features of the grounded grid and grounded cathode amplifiers.

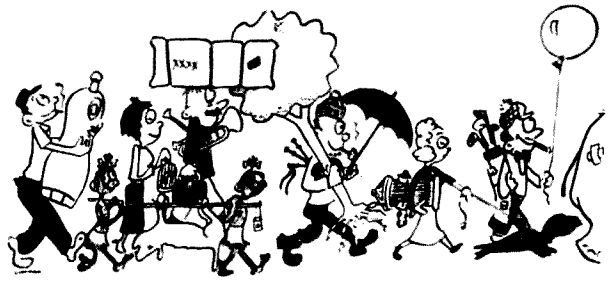
Input of the grounded grid circuit is low impedance; that of the grounded cathode is moderate. Output impedance of the grounded grid is high; that of the grounded cathode is moderate. Current gain of the grounded grid is less than 1; that of the grounded cathode is moderate. The grounded cathode circuit reverses phase between input and output; the grounded grid does not. (General course, part V)

52. How is the bandwidth of an FM signal related to the bandwidth of the modulating audio signal?

The bandwidth of an FM signal is related to the bandwidth of the modulating audio signal in a complex manner which depends upon the modulation index. At low values of modulation index, when only the first pair of sidebands is significant, the FM signal's bandwidth (like that of an AM signal) is twice that of the modulating signal. As the modulation index increases, the bandwidth increases also. At a modulation index of 5 (used in commercial FM broadcasting), the bandwidth is 10 times that of the modulating signal. (General course, part IX)

This concludes the study list questions for the General class license. These questions also apply to the Technician and Conditional class license examinations, which embody the same technical content as the General class.

. . . Staff



Moving? Please let us know.

TECHNICAL AID GROUP

The Technical Aid Group is a group of hams who have indicated a willingness to share their knowledge and skills with others. They have volunteered to be of service to fellow hams and do so without compensation. If you have a technical question, look over the list to see who has competency in the area of your question. For many of the TAG members, descriptions of all areas of expertise would be lengthy, so an abbreviated description is given. When stating your problem, give as much information as possible and clearly state the difficulty. Enclose a SASE for reply.

For those hams who have a desire to share, the TAG is the thing for you. Send a brief note requesting the membership form, fill it in and send it back. It asks a few questions about your qualifications, and there is a check-list to indicate your fields of competence. These cover all modes currently used by hams, antenna design and theory, transmitter and receiver design for HF, VHF, and UHF, logic, ICs, general help, and other areas. As more members are added, their names and addresses will be published.

This list is not complete, but represents those former TAG members who have responded to a recent mailing and have expressed a desire to continue in the program. Comments from them indicate that they have enjoyed helping and all have been contacted frequently for advice.

Robert Perlman WB2VRW, 3 Josten Place, Hudson NY 12534. Electrical engineering student. Will help with Novice transmitters and receivers, and any help for beginning hams.

Thomas Laffin W1FJE, Box 133, Hillsboro NH 03244. Radio communications technician. Special aid to ex-CBers and those who need terms in easily understood terms; aid to Novices and Techs interested in MARS, RACES, CD, and CAP; how to build and scrounge parts; assistance on ham history, ATV, microwave, and general help.

Theodore Cohen W4UMF, 8603 Conover Pl., Alexandria VA 22308. Geophysicist. Specially prepared to answer questions about SSTV and ATV.

J. Bradley Flippin K6HPR, 116 Montecito Ave., Apt. M., Monterey CA 93940. Electronic engineer. Help with RTTY, data processing and programming, general.

Ira Kavaler WA2ZIR, P.O. Box 54, Flatbush Sta., Brooklyn NY 11226. Electrical engineer. Assistance offered in theoretical aspects of electricity and electronics from dc to UHF, design of equipment, computer programming, and signal circuit (failsafe) design.

Jon Teich WB2JAE, 22 Olden Rd., Edison NJ 08817. High school student. Novice and others, transmitter and receiver problems, logic, and general.

David Felt WB6ALF, P.O. Box 261, Sierra Madre CA 91024. Electronics engineer. Qualified help in logic, digital and analog design, solid state, AM and TV.

Robert Groh WA2CKY, 65 Roxborough Rd., Rochester NY 14619. Communications engineer. Bob can lend a hand in HF and VHF transmitter and receiver design as well as solid-state logic and digital techniques.

Carl Miller WA6ZHT, 334 Paragon Ave., Stockton CA 95207. Computer technician. Carl's specialty area is solid-state QRP.

George Daughters WB6AIG, 1560 Klamath Dr., Sunnyvale CA 94087. Research associate. HF transmitter and receiver, SSB, and solid state, are George's fields.

D. Hausman VE3BUE, 267 Northcrest Pl., Waterloo, Ontario, Canada. Student. Novice transmitter and receiver problems as well as logic, digital techniques and ICs.

Hugh Wells W6WTU, 1411 18th St., Manhattan Beach CA 90226. Electronics instructor. Hugh can help with AM, Novice problems, VHF-UHF receivers and converters, solid state, test equipment, FM and repeaters, and general help.

Charles Hill WA7LQO, 4005 Campbell St., Baker OR 97814. Student. TV, Novice transmitter problems, and logic.

John Perhay WAØDGW, Route 4, Owatonna MN 55060. EE technician. John will help with RTTY, AM, SSB, Novice gear, HF transmitters and receivers, solid state, ICs, and test equipment.

Jim Jindrick WA9QYC, 801 Florence Ave., Racine WI 53402. Consulting engineer. General help as well as HF, VHF, and UHF antennas, transmitters, and receivers.

William Welsh W6DDB, 2814 Empire Ave., Burbank CA 91504. Electronic engineer. Beginner's problems, code instruction, theory and regulations.

Ken Knecht K8VNT, Box 39, Clintondale NY 12515. Television engineer. TV, logic, and digital techniques.

Tom O'Hara W6ORG, 10253 E. Nadine St., Temple City CA 91780. Communications engineer. RTTY, TV, AM, SSB, VHF antennas, transmitters and receivers for HF through UHF, solid state, and general help.

Bruce Creighton WA5JVL, 2517 Metairie Ct., Metairie LA 70002. Electrical engineer. Antennas, Novice problems, solid state, logic, digital techniques, test equipment, and general help.

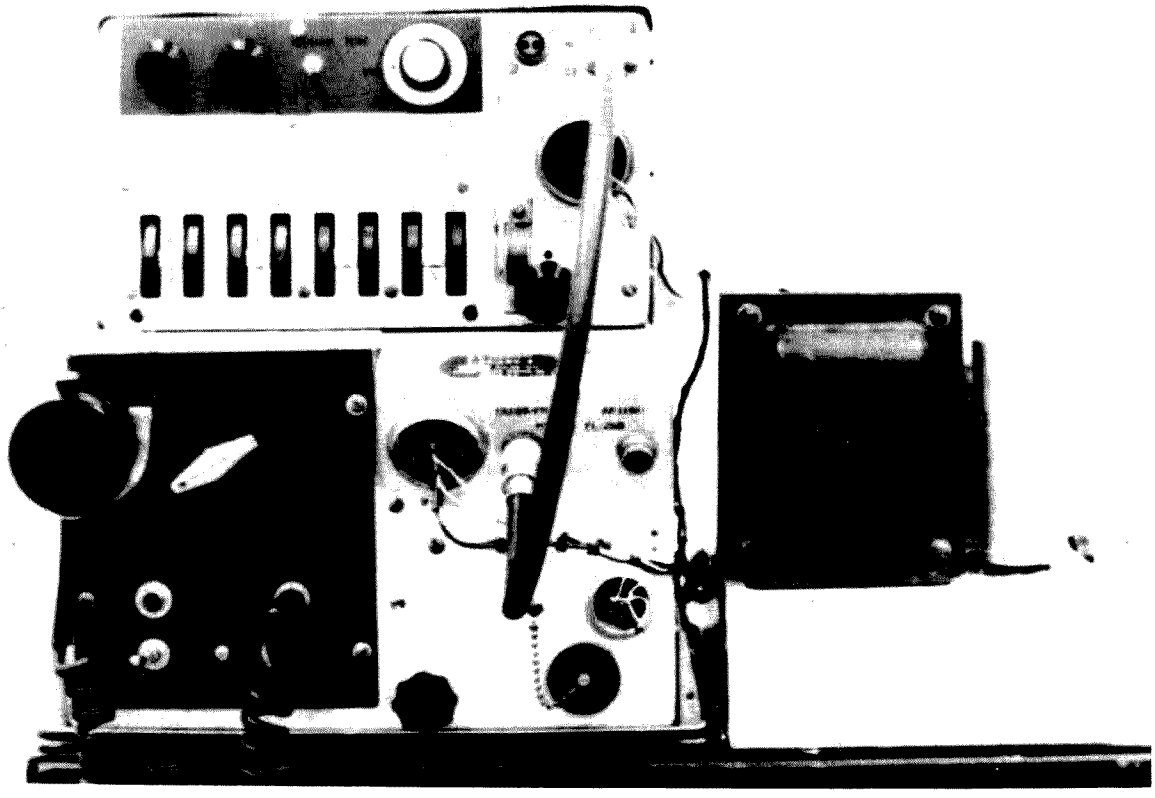
Tom Borok WB2PFY 215-33 23 Rd., Bayside NY 11360. Student. Tom is especially qualified to help Novices with their problems with transmitters and receivers, HF and VHF antennas, HF receivers, test equipment, and surplus, Morse code instruction.

Roger Taylor K9ALD, 2811 William St., Champaign IL 61820. Engineer. Roger is adept with AM, SSB, antennas, solid state, logic and digital techniques, ICs, test equipment, and other general help.

Orris Grefsheim WA6UYD, 1427 W. Park St., Lodi CA 95240. TV technician. Orris is capable of assisting in all fields of amateur work, DC through UHF, logic as well as Novice help.

John Allen K1FWF, 112 Edgemoor Lane, Ithaca NY 14850. Technical director. John's areas of assistance are VHF and UHF antennas, receivers, and transmitters, solid state and digital techniques, ICs, and SSB.

Putting The ARC-3 On Two



Neale C. Hightower WA4NAI/4
160 Fourth Street NW
Atlanta GA 30313

For the amateur who wants a step up from the lunchbox class of 2 meter equipment (no slurs intended) the AN/ARC-3 offers an excellent low-cost opportunity. A moderately stocked junkbox and a little scrounging can put the units on the air for an additional $10–15 cash outlay.

The ARC-3 system consists of five basic units: receiver, transmitter, control box, antenna, and dynamotor assembly. Only the transmitter and receiver are used in this conversion. Mating plugs are a matter of preference and cost. For fixed work a scheme is presented to avoid the need for these plugs. For a mobile installation, it is probably advisable to purchase these units if they are available. A good schematic is essential for this work, as is the case with most conversions. If one is not available from the supplier of the units, Bill Slep Co.[1] will supply separate schematics of the units. The price is $1 each.

Very few amateurs have the same needs or desires in equipment. Thus this conversion is presented as a number of "subconversions." Almost all are independent of each other. One can tailor the conversions

to suit his particular application by installing the features most useful to him.

Before starting the conversion, it is a good idea to have a rough idea of how the system works. Figure 1 shows a block diagram of the receiver system. The layout is conventional except for the automatic tuning mechanism and the harmonic generators. All frequencies (100–156 MHz) are tuned in 7 bands using 8.0 to 8.5 MHz crystals on their 11th to 18th harmonics. The harmonic generator chain is fairly narrowbanded; therefore, when it is detuned slightly from its center (the stages are not tuned to integral multiples of the crystal frequency), the output drops rapidly. Once a new channel is selected, relays change the appropriate crystal and a control tube senses that the harmonic chain is detuned. The tuning motor is started, turning the tuning mechanism. Normally, the tube would cause the motor to tune to the next harmonic and shut off when the chain output equaled the 14V reference. But if the previous channel was on the 12th harmonic and a frequency using the 17th harmonic was desired, the system would stop at the next harmonic (13th) instead. To prevent this the coding wheels

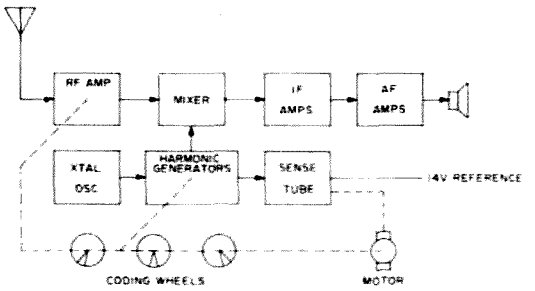


Fig. 1. Block diagram of receiver system.

are added. They select the proper harmonic and "kill" the harmonic chain output until the tuning mechanism is in the proper range. Then the output of the harmonic generators is applied to the sense tube for exact tuning.

The transmitter block diagram is shown in Fig. 2. Since it uses crystals from 5.5 to 8.6 MHz, all on the 18th harmonic, it is

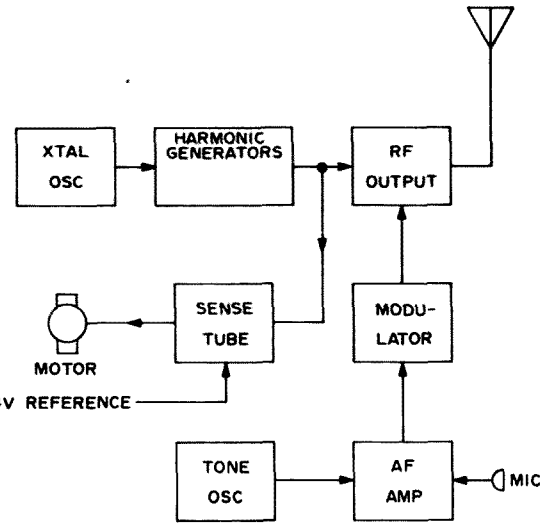


Fig. 2. Block diagram of transmitter.

only necessary to determine when the multiplier and output stages are in tune. The tuning mechanism is basically the same as that of the receiver except that the coding wheels are not employed.

Converting the Receiver

Unless it is to be used in some configuration very similar to the original, the following changes are recommended for the receiver:

1. Rewire the filament string for 12V
2. Provide an external B+ supply
3. Add an external audio gain control
4. Add external speaker (or headphones)

Two other features may be added:

5. Manual (continuous tuning)
6. Rf gain control

Filament String Conversion

The 24V filament lines may be converted for us on 12V (ac or dc) by the following procedure:

Identify R-201 (252Ω). It shunts the filament of V201; one side is connected in five leads, two on one post, three on another. The posts are jumpered together. Remove the jumper and all five wires. One wire goes back to V201. Reconnect it to the R201 post and add a jumper from this post to ground. Another wire goes to V205 through C206, the center feedthrough ca-

pacitor beside the tube. Identify this lead with an ohmmeter and attach it to the R201 post. Attach the other three wires to

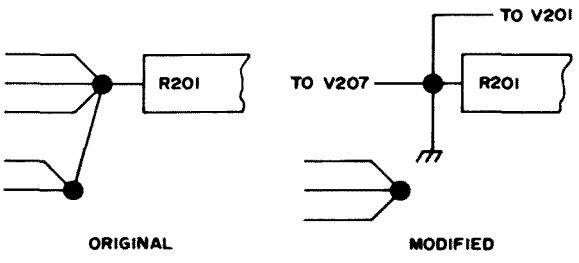


Fig. 3. Detail of 12V filament conversion.

the now empty "other" post. This change is described in Fig. 3. Identify the three posts on the rear of the brake, K202, which is located near the motor gearbox assembly. Two white wires are connected to the centerpost. One goes to pin 8 of V216. Connect this wire to some nearby groundpost. Replace the other wire Now run a new wire (20 AWG or larger) as indicated in Table I.

Table I. ARC-3 Wire Routing

From	Pin	To	Pin
V216	7	V215	8
V215	8	R291	7
R291	7	V212	7
R291	7	V207	7*
V207	7	V203	3
V216	7	V209	4**

*If the filaments are to run on ac, disconnect R225 from pin 7.

** This is best done at a post near V209 to which R202 is connected.

Remove the lead from pin 2 of V207 and connect it to pin 7. Ground pin 2. If dc filaments are to be used, the conversion is now complete. The filament supply is now pin 12 of P202. Remove R291.

For ac operation (and utilization of the automatic tuning) a small dc supply must

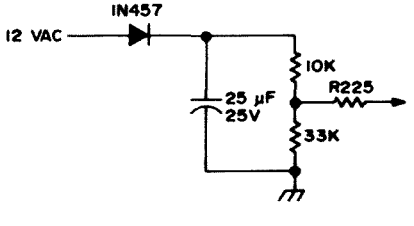
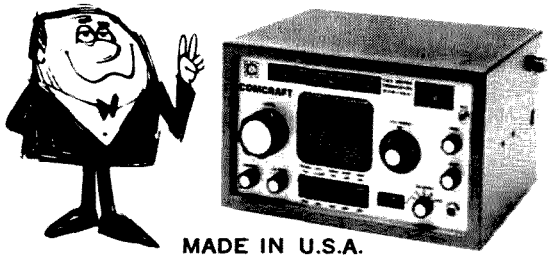


Fig. 4. Power supply for autotune operation.

2 Rigs in one!

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The First AM-FM Solid-State Transceiver For Two Meters

No longer is it necessary to choose between AM and FM on two meters. Now you can have both in one compact unit. Join the gang on the new FM repeaters yet still be able to "rag chew" with old friends either AM or FM anywhere in the two meter band.

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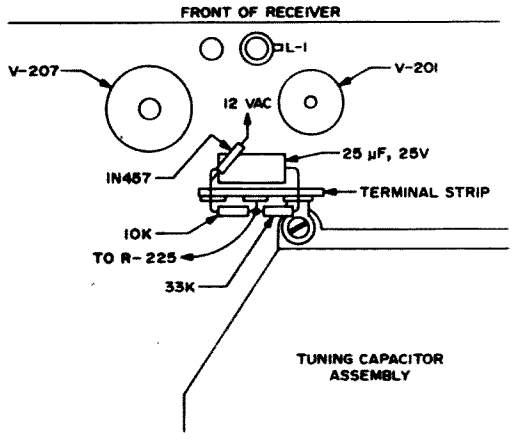


Fig. 5. Detail of autotune power supply mounting.

be added to produce the 14V reference. (If the filaments are ac powered and the autotune is unused, remove R225.) This reference voltage was originally derived from the center of the filament supply for V207 and V210. A peak rectifier and voltage divider may be added as shown in Fig. 4. The diode can be almost any type. The supply is mounted on a 3-terminal strip between V201 and V207 (Fig. 5). The ground lug is mounted under one of the bolts securing the tuner assembly to the chassis.

External B+ Supply

The supply shown in Fig. 6 is for both the transmitter and receiver. For those contemplating a mobile supply, the data in Table II should be helpful.

Table II. ARC-3 Voltage Requirements

Function	Power
Filament	12V, 7.5A
Receiver B+	225V, 100 mA
Transmitter B+	410V, 325 mA
Relays	28V, 500 mA

Table II. ARC-3 Voltage Requirements

To power the tuning motors, it is necessary to have a supply capable of delivering about 6A at 28V. Any less capacity will cause the autotune mechanism to malfunction. Thus automatic tuning for fixed (ac) work is not recommended.

The power transformer used was scrapped from an old (very old) television. It has a centertapped 12V winding to handle the necessary current. An exact replacement is not known, but only transformers from "monster" TVs will work. Instead, for most work it would probably be better to use two transformers. The inductors were removed from old TVs. As can be seen, the parts used are mostly junk, so feel free to substitute.

Connection to the receiver and transmitter was effected by removing the pin connectors from an octal socket. The older "wraparound" type were employed. If these are not available, most hobby shops carry small brass tubing which could be used.

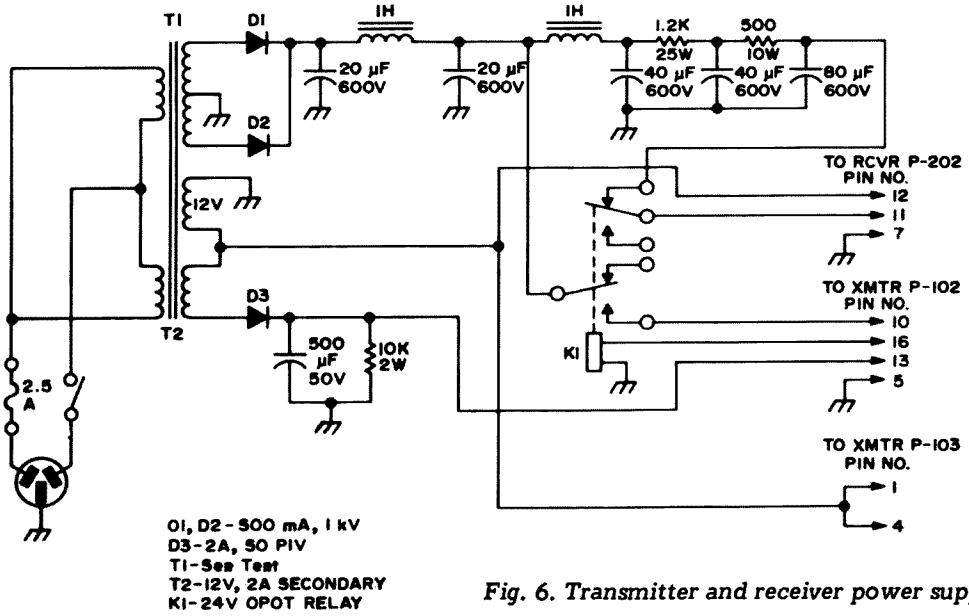


Fig. 6. Transmitter and receiver power supply.

The power supply used at WA4NAI was adapted from use on another project. A supply using a different layout would be more practical and esthetically pleasing.

Audio Gain Control

Disconnect C294 from pin 1 of V216. Remove R280, C296, R289, and R290 from the other side of C294. The last three components are mounted on the rear of the chassis on a point-to-point board. Remove R281 and R284. Add the audio gain control as shown in Fig. 7. One of the points cleared by the removal of C294 may be used as a tie point. If the leads are to be extended beyond the chassis, it would be wise to shield them. Moving one side of C294 significantly increases the gain of the stage.

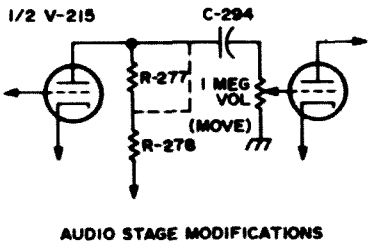


Fig. 7. Installation of audio gain control.

External Speaker

Two output impedances are available for a speaker at pins 16 and 17 of P202. Pin 16 is 50Ω and pin 17 is 600Ω. The 600Ω output could be used directly with headphones. A 600Ω line-to-voice-coil transformer may be installed to match a 4 or 8Ω speaker. One might also use a 45Ω speaker directly across the 50Ω output. Those wishing to replace the output transformer can use the Stancor A-3879. If the 12A6 tube is defective or missing, it can be replaced with the more common 12V6.

Tuning

The ARC-3 was originally designed for crystal-controlled reception on 8 different preset channels. If channelized operation is desired, all that is necessary is to supply 28V to the A+ terminal of P202 and 12V to pin 12. Attach a switch as shown in Fig. 8 and install crystals as determined by the following formula:

Where: F_C = xtal freq, MHz.

$F_C = (F_O - 12)/n$ F_O = operating freq, MHz.

n = harmonic ($8.0 \leqslant F_C \leqslant 8.5$)

Manual Tuning

Continuous tuning requires the conversion of the crystal oscillator to a tuned-grid-tuned-plate oscillator. In addition, one must arrange some method of keeping the rf and multiplier stages in tune. Several different schemes are possible, but the one presented seems the best for simplicity and versatility. The automatic tuning and relay logic are simply left unused by a combination of electrical and mechanical methods.

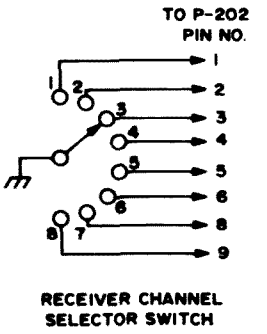


Fig. 8. Hookup for channelized reception.

Oscillator Conversion

Conversion of the oscillator involves replacing the crystal with an LC circuit tuned to roughly 8 MHz, adjustable over the desired range. Details of the circuit are shown in Fig. 9. To begin the conversion, remove the wire to pin 6 coming from the relay bank. L1 is mounted in the now vacant hole near V201. C1 is mounted on the front panel (over the old relay cavity). Connecting leads are threaded through the holes in the crystal sockets.

Alignment of the tunable oscillator can be done with reasonable accuracy on the air. Choose a signal near the bottom of the

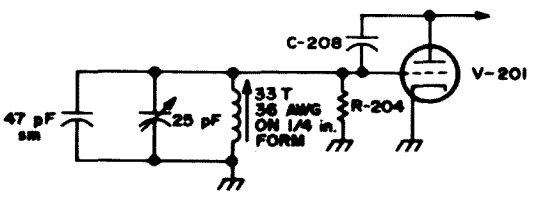


Fig. 9. Conversion of crystal oscillator to VFO.

band of known frequency and set the tuning capacitor to about 90% meshed. Now tune in the signal with the slug of L1 (it may be necessary to add or remove one or two turns). Three signals spotted across the band should give a reasonably accurate dial scale. Of course, a better job can be done with a signal generator.

In a mobile installation, it might be desirable to tune the oscillator remotely with a varactor. A suggested hookup is shown in Fig. 10.

Continuous Tuning

For fixed station use, a shaft and gear system are installed in the old squelch level access hole, and the control is moved to the rear of the chassis above the 12H6 detector. Begin by turning over the receiver and loosening the front, removing five screws on each side. Press the brake mechanism manually and turn the tuning shaft so that both setscrews designated in Fig. 11 can be reached with a splined wrench without again turning the shaft (this assures that alignment will not be lost between the tuning capacitors and the front dial). If the screws don't come out easily, heat them with a soldering iron and they will almost fall out. Carefully slide the front loose and remove the squelch control and bracket. Disconnect the control and mark the leads so that they can be extended to some other location. Drill out the brad which holds the slide assembly covering the squelch access hole. Mount an old potentiometer bushing in the access hole (ream it slightly). Figure 12 shows the mechanical details of the conversion. The gears used in this conversion are from the depths of a friend's junkbox. One could also use gears from an erector set (write the company or bargain with Junior), a slot car supply center, or belt and pulleys from an

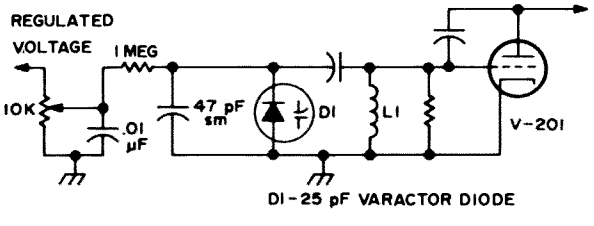


Fig. 10. Remote oscillator tuning circuit using a varactor.

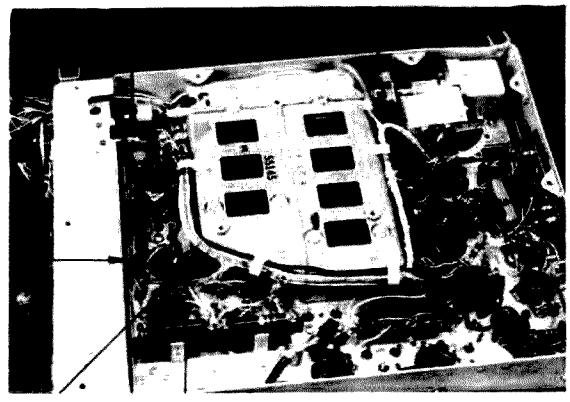


Fig. 11. Photo of manual tuning conversion.

old phono motor (use your imagination). Certain surplus equipment such as old bombing navigation devices is often a good source of small gears. Finally remove or loosen the setscrews shown in Fig. 11.

Tuning the receiver is like tuning a communications receiver having a preselector. Choose the approximate frequency of operation with the rf stages then tune the signal with the oscillator. Finally peak the RF stages.

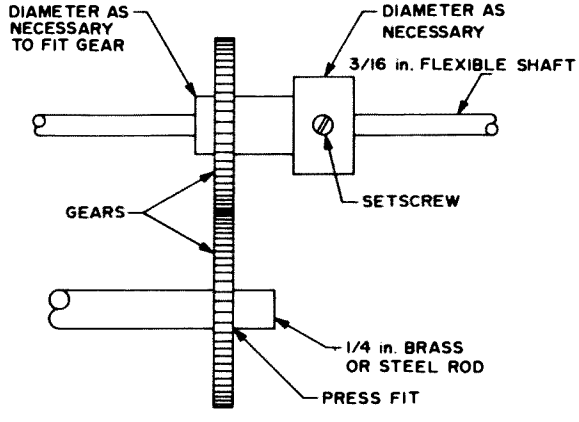


Fig. 12. Mechanical details of manual tuning conversion.

Rf Gain Control

An rf gain control may be added without too much trouble. The hookup is shown in Fig. 13. The pot is a half-watt unit, and any value near 25 kΩ will do.

Begin by removing the cover plate over the section of the tuner assembly which mounts V208 and V209. Carefully lift the ground end of R236 and add a one-lug terminal strip directly outside the side plate. Extend the ground end of R236 to

the lug. One can now run a wire from this lug to the front panel.

Transmitter Conversion

The transmitter involves somewhat less conversion than the receiver, since the output is left crystal-controlled. The bulk of the labor involves attaching a front panel and extending control leads to it. Additionally, a manual peaking feature for the rf stages is presented to avoid use of the automatic tuning motor and its accompanying 28V high-current supply. Provisions are made for a relative output indicator and a 12V filament supply.

12V Filament Supply

The transmitter filaments draw about 4.5A at 12V. In many cases, a transformer capable of handling this load is expensive.

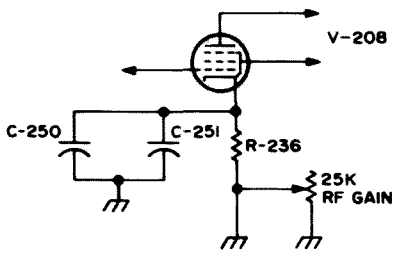


Fig. 13. Addition of rf gain control.

But a TV power transformer could be used by placing the 6 and 5V windings in series. The 5V winding is usually good only for a little over 3A. By bringing out a separate lead for the 6L6 modulator filaments, however, the filament drain can be split into 3.5 and 1A sources, as shown in Fig. 14. If such an arrangement is not necessary, the two separate lines can be paralleled.

Identify R132. Three leads are connected to one side. One goes to pin 7, V108. Remove and ground it. Remove the other two leads, solder and tape them together. Identify R131. Place a jumper across it or remove it and tape the leads together. Identify and remove R133 and the lead going from it to pin 7, V105. Remove R129 and R130, taping up the remaining leads.

Identify pin 7, V103. Remove both wires and solder and tape them together. Ground pin 7. Remove the lead from pin 7

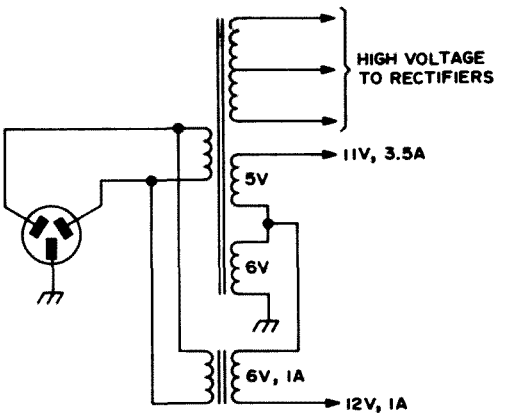


Fig. 14. 12V filament power supply.

of V102. Run a 20-gage or large wire via the following chart:

FROM	PIN	TO	PIN
V104	1	V105	7
V105	7	V102	2
V102	2	R132	tap
V105	7	P103	1
V107	2	P103	4

The 12V (ac or dc) can now be fed into pins 2 and 4 of P103 with 3.5 and 1A sources.

Front Panel Controls

Remove the crystal compartment door and fit a new piece of aluminum for the front panel. This is best done by using four sheet-metal screws. Removal of the relay contact covers should provide sufficient clearance for jacks, switches, etc. Details of

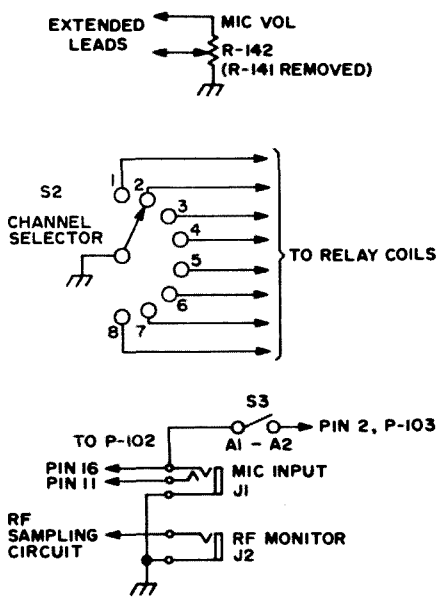


Fig. 15. Wiring of front panel controls.

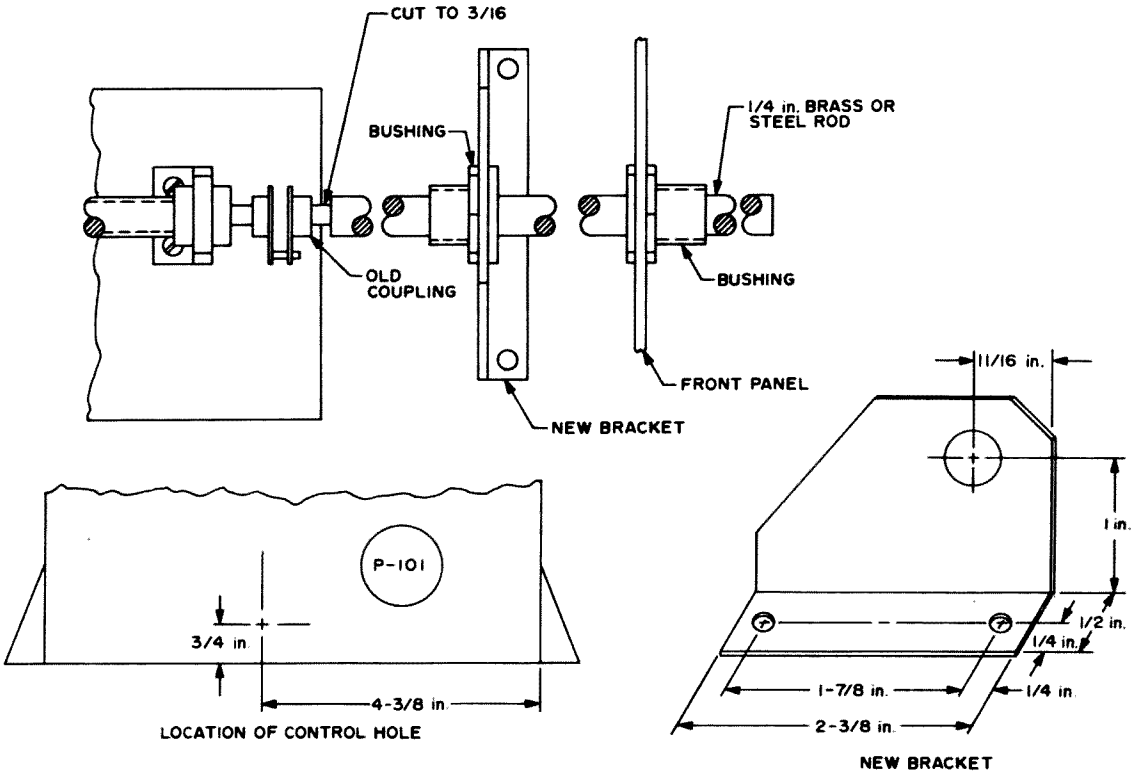


Fig. 16. Mechanical details of manual peaking control.

the hookup are shown in Fig. 15.

Microphone volume was originally controlled by an aneroid barometer attached to a potentiometer. This is the large can or cylinder directly behind the crystal switching relays and is marked R142 on the schematic. Remove and disassemble it, extending the connecting leads to the front panel. Extract the potentiometer and remount it on the front panel.

To avoid making a number of connections to the front of P102, I decided to connect S2 through the relay rack compartment directly to the coils. This involves removing the phenolic covers and cutting a small hole in the top cover to clear the leads. Removal of the back cover involves some unusual arrangements. There are two wires going through it which must be unsoldered to effect its removal. Instead I extended the slit through which they ran to the bottom of the plate. This can be done with a hacksaw blade or small file. Wires were then soldered to the side of the relay coil not having a jumper to one of its own contacts.

Power leads are attached in the same manner as to the receiver. The A1–A2 switch allows the transmitter to be keyed A2 with its internal oscillator with the microphone PTT connection. For A1 or A3 it is left in the A1 position.

Manual RF Peaking

Unless a 28V, 6A power supply is available, automatic tuning is not recommended. The supply shown in Fig. 6 is not capable of handling the load of the tuning motor, but will feed the keying and crystal switching relays nicely. Manual peaking of the rf stages requires relatively little conversion.

Begin by locating motor B101. It is mounted by six screws which attach through the main chassis to standoff posts. Remove all six screws and the motor–brake assembly. Cut and tape all three leads connected to it. Using a splined wrench remove the drive coupling from the end of the asssembly. Also remove the two center standoff posts and reinstall them on the chassis in their old location. Drill a hole

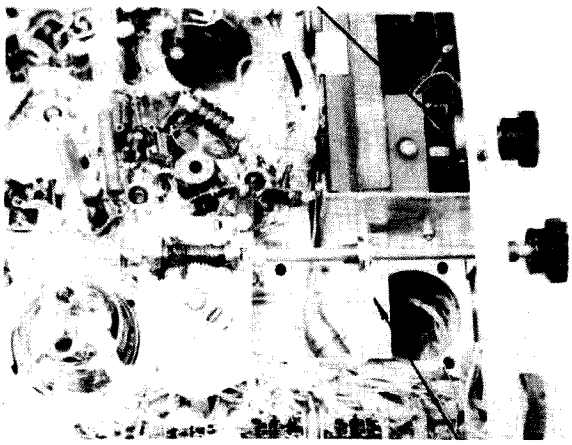


Fig. 17. Installation photo of manual tuning feature.

to accept an old potentiometer bushing as shown in Fig. 16. The ¼ in. shaft must be cut down to 3/16 in. on one end. If no other method is available, one can put the rod in the chuck of a ¼ in. drill and hold a file against it until the proper diameter is reached. The method is crude, but works. Mount another bushing in the new bracket described in Fig. 16. Install the entire assembly as shown in Fig. 17.

Locate K107. Remove the jumper going from the coil to one of its own contacts. This frees the PTT system to work without the tuning mechanism.

In operation the transmitter is peaked up by observing the output. A relatively small excursion of the tuning knob covers the entire 2 meter band.

Relative Output Indicator

The output indicator is shown in Fig. 18. The diode can be almost any rf type. Output is about 1–2V.

Afterthoughts

The speaker in my receiver was mounted in the top of the cabinet over relay K201 and V207. It was necessary to remove these items to obtain clearance for the speaker and transformer. Others may wish to use another mounting location or speaker size.

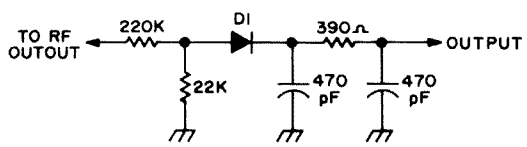


Fig. 18. Output indicator.

Figure 19 shows some of the connector layouts and a few miscellaneous dimensions which may be of help in the conversion of these units. All diagrams are front views.

Many of these ARC-3 units have been sitting unused in warehouses for some time. Therefore components may have aged considerably and it may be necessary to repair the units before they are converted. A borrowed 28V high-current supply can be used to operate the equipment in its original configuration long enough to assure proper operation. If problems are encountered, be suspicious of the capacitors, as they are wax units and often leak or short. This preliminary checkout is highly recommended. It can save many headaches later.

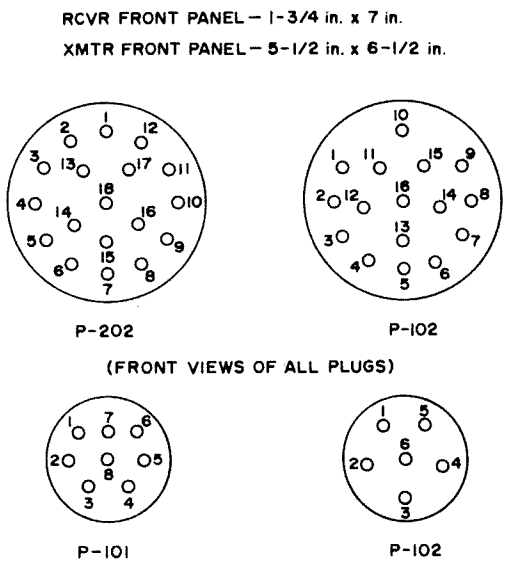


Fig. 19. Connector pin diagrams.

The transmitter was originally set up to cover the entire 100–156 MHz band. By peaking the rf chain in the center of the 2 meter band, considerably more output is available than for the wider band coverage. The tech manual gives complete information on the procedure.

Thanks to Paul G. Branson, Richard Patisaul (WA4ARQ), and Thomas F. Evans for their assistance and encouragement in this work.

. . .WA4NAI■

1. Drawer 178P, Highway 301, Ellenton FL 33532

Ed Baker WØEDO
224 N. Buckeye
Iola KS 66749

BLOWN FUSE INDICATORS For LOW VOLTAGE

At first glance the unit to be described would appear to be strictly a luxury, but use it once, and you'll wonder how you ever got along without it.

It is a well known fact that individually fused circuits not only give increased protection to equipment, but simplify troubleshooting by isolating the defective circuits. But it also means more fuses to check when troubleshooting.

In ac equipment it is a simple matter to connect a neon bulb directly across each fuse; thus, when all is well all bulbs are out (being shorted by the fuse). When a fuse blows, the bulb is placed in series with the load and, glows (without allowing enough current flow to damage the defective circuit). A look at Fig. 1 will make this operation clear.

I "borrowed" the idea from a piece of military gear several years ago, and have used it ever since. Many hours have been saved by knowing exactly which unit to check when something "went south."

Many times I have wished that such a system could be applied to the mobile rig, but since the 6V in my VW (or the 12 in your Cadillac) will not light a neon bulb it seemed out of the question. Then a light came on in the think department. How about incandescent bulbs? Theory could not find a flaw in the idea (at least not my limited theory) so it was decided to give it a

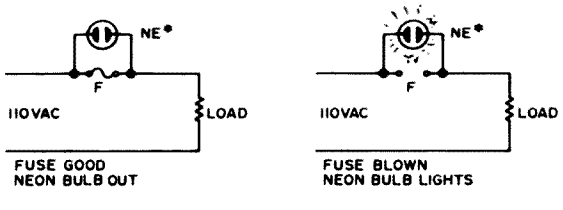
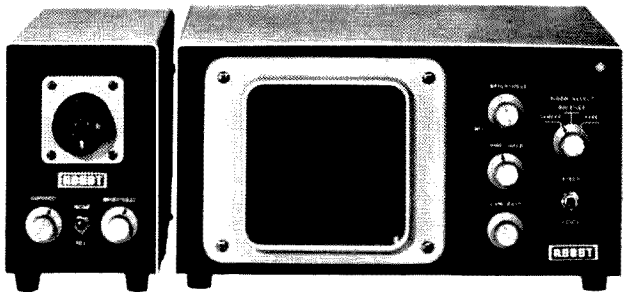


Fig. 1.

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practical test, using a sealed beam unit from a headlight as a "load." It worked!

The values used were selected for easy calculation, but the theory will hold in any

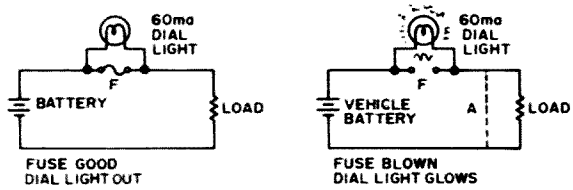


Fig. 2.

case. Assume, for example, a 6A load. The next higher rating of fuse is 10A, which should give adequate protection. Now, connect a 60 mA pilot lamp across the fuse. If all values are considered to be exact (of course they never are, but this is theory) our circuit may now conduct 10.06A before the fuse blows. If a short develops at point A in Fig. 2, the fuse will blow, but the lamp will merely have its normal brilliance, announcing to one and all that F1 has blown. If the short is only momentary, the bulb will be placed in series with the load, but application of Ohm's law will show us that our 6A load has a resistance of only 1.0Ω, while the 60 mA bulb has a resistance of 100Ω, thus most of the applied voltage will be dropped across the bulb, and it will still light.

This method worked out so well on the mobile rig that it was also applied to the entire automobile, with all the bulbs installed on a single panel just below the dash.

Unless you have a large supply of pilot light sockets and jewels on hand, this would at first appear expensive, but there is a sneaky way around this. Bulbs mount nicely in a grommet set into a hole, and coating them with a special paint made for putting orange parking lights on older model cars makes a very attractive installation. In the event the bulbs tend to creep out of the grommets, a drop of Duco cement applied to the bulb and grommet will cure this, and replacement is so seldom that connection may be made by soldering directly to the bulbs.

. . .WØEDO

Hank Olson W6GXN
P.O. Box 339
Menlo Park CA 94025

Addendum To The W1PLJ Counter

One of the best amateur radio-oriented frequency-counter articles, in my opinion, was published in *73* magazine in February 1968 by W1PLJ.

Although the W1PLJ counter was designed around RTL logic, considered to be obsolete for new designs by many engineers, it still has much to recommend it in terms of price and performance. RTL is a logic form that was first to be IC-implemented and so has a few features upon which the newer IC logic families have improved. RTL is, however, still probably the most durable IC logic form in the hands of the beginner. Mistakes in wiring or inadvertent shorting of leads together in testing are usually forgiven by RTL. Also, since most hams are used to devices being turned "on" by a voltage input, RTL is easier to understand than the more sophisticated "current sinking" logic forms (DTL or TTL).

The original counter article was written in such a way as to allow the builder to choose from a number of ICs (Fairchild or Motorola), and so IC pin numbers were not given. As such, the article was not *really* a construction article.

I began construction of the W1PLJ counter by the hand-wired method used in the original article. After making two of the

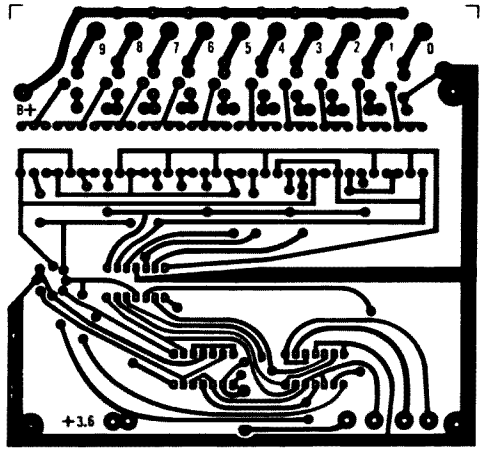


Fig. 1. DCU board layout. Boards will be made available by Stafford Electronics Inc., 427 S. Benbow Rd, Greensboro NC 27401.

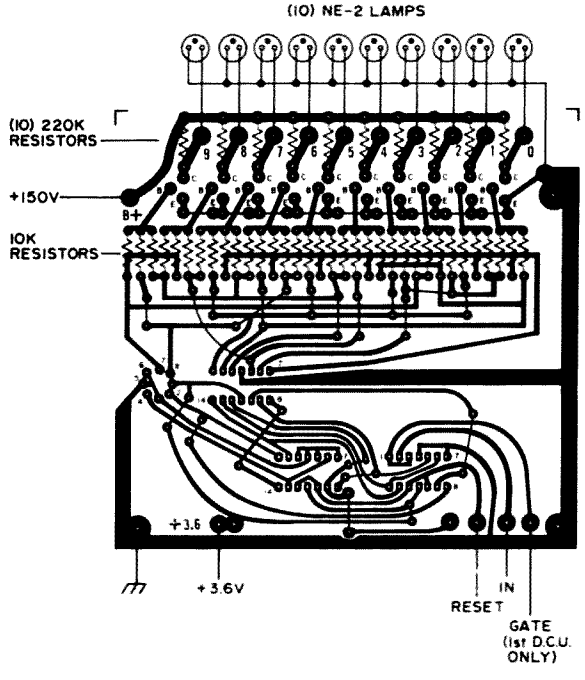


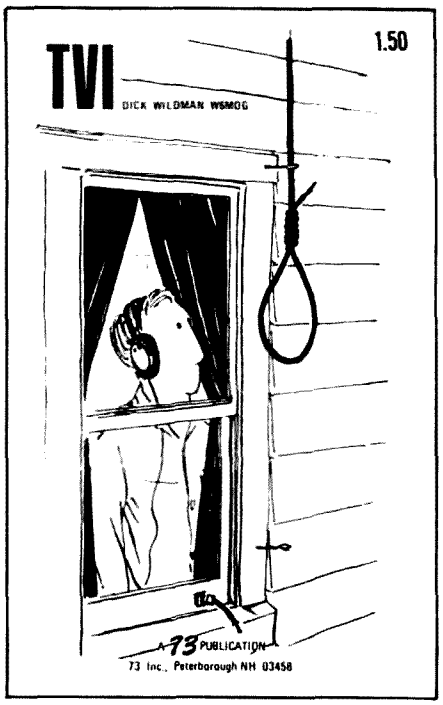
Fig. 2. Parts layout of DCU.

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Decade Counting Units (DCUs), the task seemed to have no end in sight. This much of the counter was a "shot in the arm," however, as I could hook the DCUs up to +3.6V, +150V, and a pulse generator, and watch them "count" and display. In order to simplify the repetitive job of constructing DCUs, a PC board was taped up, as shown in Figs. 1 and 2. This board makes building the counter much easier, combined with another simplification. The neon indicator systems were pulled off old Hewlett Packard AC4A tube type DCUs (the ones that had four 12AU7s in them). These are often available in surplus stores, and really speed up the mechanical implementation of the display, since the numbers and so forth are all there. Similar DCUs that are suitable were made by Berkeley and Detectron, but the H.P. units were the easiest to use in my opinion. I personally wouldn't pay much over $3 for an old AC4A (without tubes) since the price of ten NE2s is only about $1 and that of the least expensive "nixie" (Burroughs B5750) is only $6.75.

The particular transistors used on my DCU boards were 2N720As which I happened to find a "good deal" on, but the 2N1893s or 2N3877s recommended by W1PLJ will also fit the board. The ICs chosen for the PC board *do* cause some restriction, but those specified are the least expensive choice for eight RTL inverters in two IC packages, and two dual JK flip-flops. (The Motorola HEP parts will be somewhat

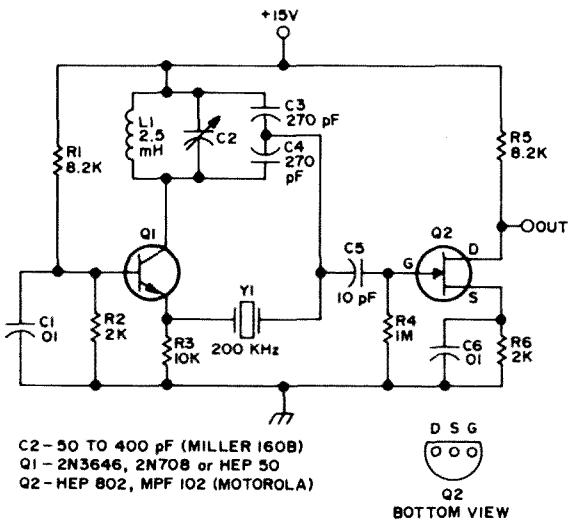
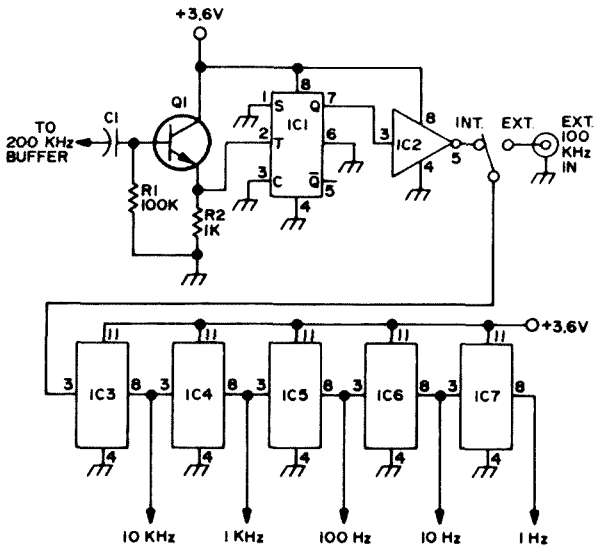


Fig. 4A. 200 kHz crystal standard for counter time base.

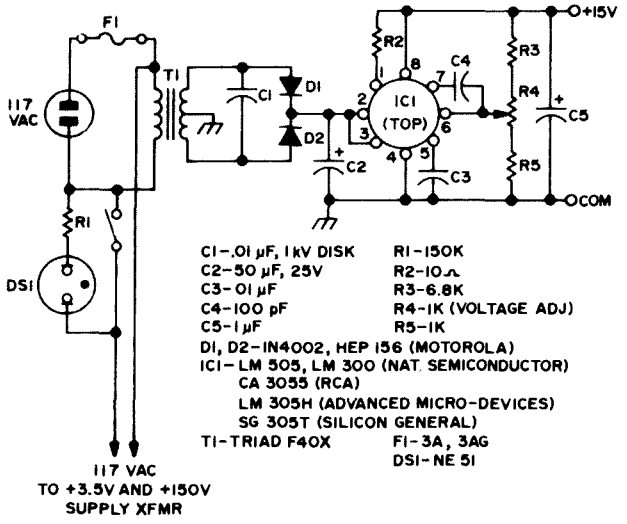


C1 - WIRE "GIMMICK"
IC1 - μL 923 or HEP 583
IC2 - μL 900 or MC 800G (MOTOROLA)
IC3 TO IC7 - MC 780P (MOTOROLA)
Q1 - 2N5646, 2N708 or HEP 50

Fig. 3. Divider section.

more expensive than the Fairchild μA and Motorola MC numbers they replace, but the HEP parts are more generally available.)

The other simplifying modification of the counter was the use of MC780P decade counter ICs. These ICs were unavailable when W1PLJ wrote the original article. They make the frequency standard divider section much easier to wire and eliminate any divider adjustments. The MC780P costs about five cents more than two MC790Ps, which were used as the two lowest frequency decades in the original counter, but are well worth it in simplification. The new divider section is then as shown in Fig. 3.



C1 - .01 μF, 1 kV DISK
C2 - 50 μF, 25V
C3 - .01 μF
C4 - 100 pF
C5 - 1 μF
D1, D2 - IN4002, HEP 156 (MOTOROLA)
IC1 - LM 505, LM 300 (NAT. SEMICONDUCTOR)
CA 3055 (RCA)
LM 305H (ADVANCED MICRO-DEVICES)
SG 305T (SILICON GENERAL)
T1 - TRIAD F40X
R1 - 150K
R2 - 10Ω
R3 - 6.8K
R4 - 1K (VOLTAGE ADJ)
R5 - 1K
F1 - 3A, 3AG
DS1 - NE 51

Fig. 4B. Regulated power supply for 200 kHz crystal standard.

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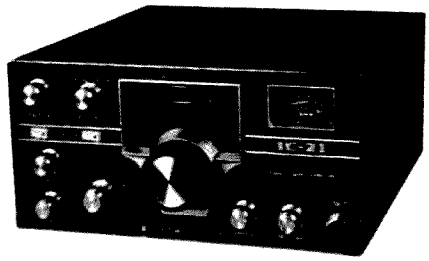
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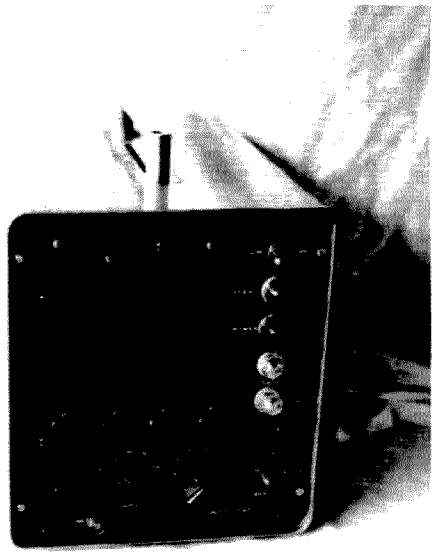
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Completed counter.

The original counter article did not show a power supply for the crystal standard, and so a new crystal oscillator and regulated supply for it was designed to fit my particular needs. The use of the LM305 IC-regulator very simply accomplishes the job of obtaining a small amount of regulated +15V needed for the crystal oscillator and buffer. Note that a 200 kHz surplus FT241 crystal was used in this version of the counter. While it may be argued that the 1 MHz crystals (being AT cut) are more stable than the crystal used here, the 200 kHz FT241 is quite adequate for the four-place accuracy of *this* counter. These 200 kHz crystals are available from JAN crystals for $1.75 plus 10¢ postage (*Jan Crystals, 2400 Crystal Drive, Ft. Myers FL 33901*).

The finished counter as packaged is shown in the photograph. This counter has been immensely helpful in routine lab work for setting oscillators to frequency *quickly*, and many other tasks. The main advantage of a counter is not its great accuracy, but rather its great *speed* of reading out frequency. Since the counter does all the work, for instance, you can connect it to an oscillator that you are slowly heat-cycling and look up only occasionally to log the temperature and frequency. In short, it is a gadget every experimenter ought to have.

. . .W6GXN

Ken W. Sessions, Jr. K6MVH

Constant-Currant Charger for Ni-Cads

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If you own a hand-held transceiver with a nickel-cadmium battery pack but you don't have a charger, you've probably been going about the recharging task the hard way – connecting a low-voltage dc source to the battery, monitoring the current drain with a milliammeter, and using a pot to increase the applied current to the required rate as the battery gradually becomes charged. That's an effective system, of course, but it requires one heck of a lot of attention if you want the battery up to snuff at the end of the period.

As the battery regains its state of charge, it will tend to draw less and less current, always seeking a state of balance between the applied voltage and the battery potential. When you charge the hard way (as most of us HT owners have), it's very hard to keep track of the time on charge at the right rate, which does make it extremely easy to end up overcharging – and destroying some of the cells in the battery.

Since ni-cads should be charged for 15–16 hours at 10% of their milliampere-hour rating, the monitoring and adjustment process can keep you hopping and be a real drag. The obvious solution is to attack the problem the way Motorola does with its factory-made charging systems – that is, to use a charger whose output current remains constant over the full 16-hour charging period.

Building such a charger is an incredibly simple job. All you need are transformer, small lamp, resistor, and a diode. Since the resistor–lamp combination (and the battery under charge, of course) will determine the current drain, the pair should be selected according to the requirements of your particular battery.

A 28V transformer is right for virtually all Motorola ni-cads, which are themselves typically just over half this value. In most cases (where the battery has a capacity of a quarter of a milliampere-hour or more), the lamp itself should be a 28V type. The charger circuit is shown in Fig. 1.

The resistor should be selected to draw 25–30% of the current drawn by the lamp. You can determine the values experimentally if you have a junkbox that is fairly rich in lamps and resistors. Place a milliammeter across the charging contacts (when the battery is NOT in the circuit) and measure the dead-short current. It should be exactly twice the value of your battery's 16-hour

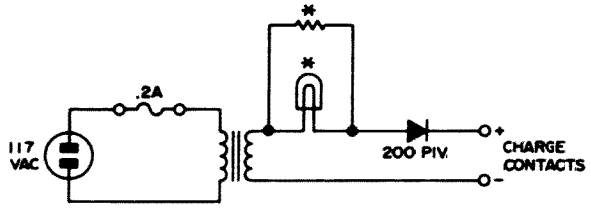
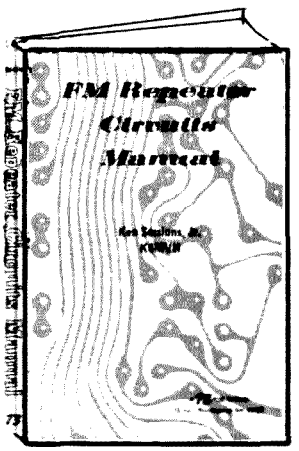


Fig. 1. Constant-current charger circuit for 15V ni-cad batteries. Caution: Don't try to charge mercury batteries with this charger or you'll have battery all over the walls of your shack!

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Table I. Lamp and Resistor Values for Popular Motorola Units

Radio	Batt Rating	16-hr Charge Rate	Resistor	Lamp Current
HT-200	500 mA-hr	50 mA	120Ω	70 mA
HT-220	235 mA-hr	25 mA*	270Ω	40 mA
HT-220 OMNI	450 mA-hr	45 mA	180Ω	70 mA
HT-100	70 mA-hr	7 mA	100K	**

*Charge for 15 hours at specified rate.
**Use a GE type B2A neon glow lamp.

charge rate. The approximate values for resistors and lamps suitable for use in chargers for most popular Motorola HTs are shown in Table I. If you use these values, be sure to double check the short-circuit current as indicated above before connecting the battery. It's possible you'll have to make some slight modifications in the resistor values, since those shown were derived by calculation rather than by an empirical process of in-circuit measurement.

When the battery is placed in the circuit (in series with the lamp), the voltage across the lamp drops to approximately half its shorted value, which will also halve the current; thus, if the short-circuit current measures 100 mA, the current will be 50 mA when a 15V battery is connected.

Now that you've got the problem of building the charging circuit licked, you'll have to use some real ingenuity to get the battery charged. The mechanical problems associated with charging Motorola batteries are mind-boggling. There's just no simple way to connect test leads to the batteries. Motorola chargers are form-fitted to the battery so that when the battery is placed in the "pocket," a set of contact pins on the bottom of the charger connect with the battery at the right spot. But if you don't have a form-fitting battery holder, you'll just have to be clever about it. I made up a little wooden box into which the battery fits rather nicely, and installed a couple of screws at the bottom for contact pins. But it would have been easier to simply buy a new Motorola charger. If you have any ideas, I'm sure the rest of 73's readers would like to hear about it.

. . .K6MVH

Clifford Klinert WB6BIH
520 Division Street
National City, CA 92050

The ESM/1 Transceiever

The ESM/1 emergency signaling device is a self-contained pocket-portable unit that has a range of up to ten miles in fair weather daytime conditions. The device is solar powered and operates in the noncoherent light band. The emission is of the CW mode. Its dimensions are four by five inches, and about a quarter inch thick. Obviously it is solid state, very solid, with no moving parts of any kind. It must be very state-of-the-art you say? No indeed, this device appears to be at least twenty years old, and is probably World War Two surplus. So what is the trick? It's very simple; it's all done with mirrors. But this is a very special mirror, so let's take a look at how this device works and how we can put it to work for us.

Theory

At some time or another everyone has probably reflected the light of the sun with a small mirror. However one problem develops if the light is to be directed to a spot a great distance away. Because of the inverse square law and a few other things, the spot of light in the distance usually becomes invisible to the operator and the means of aiming it are lost. The following discussion will explain what has been done to provide a simple and effective means of aiming the spot of light at distances of several miles.

It's easier to show than tell, so take a look at **Fig. 1**. Here we have two intersecting straight lines. The thing to notice is that the two opposite angles marked A and B are identical. This comes from a theorem in geometry, but can be seen by inspection. For those who are interested in this, a high school geometry text should clear this up.

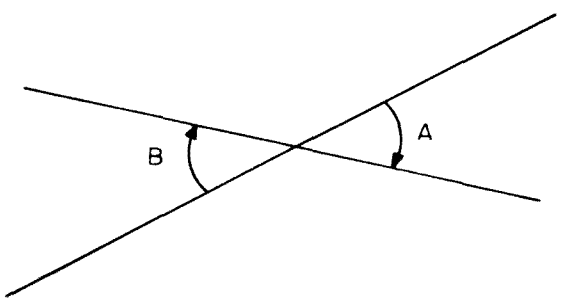
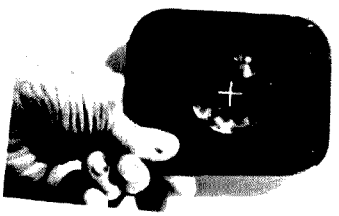


Fig. 1. Equal Opposite Angles. Note that angle A is the same as angle B.



The mirror consists of a sheet of glass with a reflective surface on one side that reflects from both front and back. This thin reflecting surface has a cross shaped opening in it that allows light to pass through the center.

With these facts established, it is possible to explain the operation of the mirror in **Fig. 2**. Starting at the light source (the sun), the light travels both the dotted and dashed line to the mirror. At the surface of the mirror, most of the light is reflected to the object of interest. However, because of the small opening in the surface, some of the light also travels the dotted line through the mirror and strikes another surface (not a mirror). The light is reflected from this surface in the solid line back to the mirror, much weaker in intensity because of the nature of the surface. Since the back of the mirror is also a silvered surface, the solid line is reflected on to the eye where it is seen as the image of a cross as projected on the surface. In the final leg of the light's travel, we focus our interest on the object. The light that makes up the image of the object travels the solid line to the eye. Since there is an opening in the mirror, the object is seen as it would normally appear, but through the hole in the mirror. It is in this configuration that proper aiming is achieved. If this explanation is not clear, the next section should clear it up.

Operation

At first glance, the instructions on the

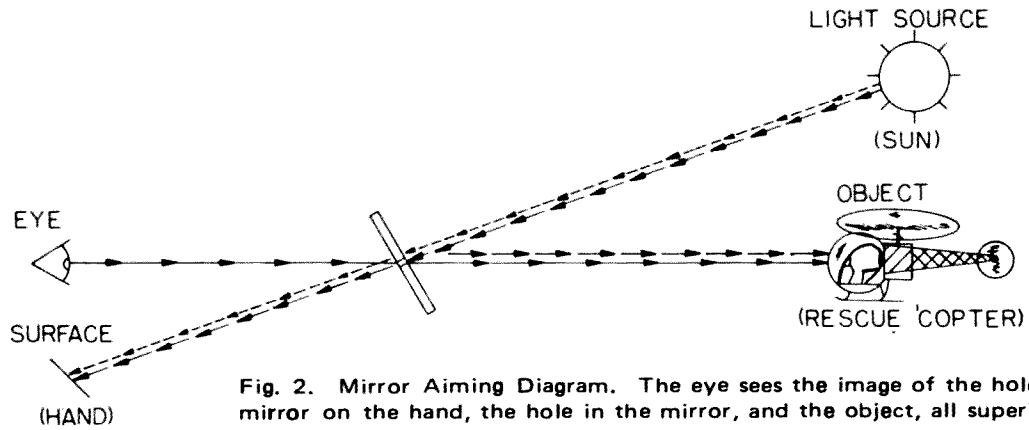


Fig. 2. Mirror Aiming Diagram. The eye sees the image of the hole of the mirror on the hand, the hole in the mirror, and the object, all superimposed on each other.

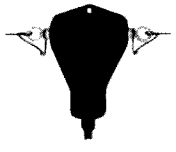
mirror are not very clear, so some instruction is in order. The first step is to hold the mirror in the sun so that the cross shaped image appears on some surface, usually your hand. Now move your eye around so that the image on your hand is visible in the mirror. Your eye should be about two or three inches from the mirror. As soon as the cross is located, line it up with the cross shaped hole in the center of the mirror. What you see in the distance through the hole in the mirror is where the light is aimed. It is simply a process of lining up the three things; the image of the cross, the cross shaped hole, and the object. Keying can be done by using slow or fast passes over the object to form dashes or dots, respectively. A little practice is required here.

The uses of this device are obvious wherever a highly portable temporary means of communication is required – so long as the sun shines. Microwave or laser paths can be checked for line of sight clearance by this simple method before actual installation of equipment. Since no license is required, anyone can use it. And, if someday you find yourself sitting in one of those little rubber boats with nothing but ocean all around, this mirror may save your life!

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Semiconductor progress in the past few years has been nothing short of amazing. The transistor has evolved from the 20 milliwatt wonder to a replacement for the 6146. Although basically aimed toward industry, this rapidly advancing technology can be of use to the amateur. One particular field of interest to the ham is that of *rf* power, where often today the transistor proves more economical and practical than the tube. Through proper transistor selection and well-designed circuits, the transistor must no longer take a back seat to the tube for economy.

Transistor Selection

The many merits of the transistor over the tube are well known to every amateur who took part in the great transistor vs. tube disputes a few years ago. But economy was seldom added to the list; "bargain" tubes and cannibalized television sets gave the tube man the edge. The story has changed, though, and today *rf* transistor list prices look a little more appealing. In the $5 and under price range a number of good rf transistors are presently available, as shown in the chart in Table 1. This cross-section of popular types cannot only give you an idea of how much performance to expect for a given amount of money, but it can help with the selection of a type for any desired application.

Two electrical specifications are given on the chart. Both are useful in the selection of transistors, yet often misunderstood. Pt, as might be expected, refers to power. Technically it stands for "the total nonreactive dc power input to all terminals". From this definition it would seem that Pt is the total dc input, and therefore the maximum power input of the transistor. Not so, however, for transistor technology defines power *output* as *negative power input.* In other words, the Pt rating refers to the amount of dc power input *minus* the output power. This corresponds to the plate dissipation of a tube, for it is a rating of the amount of power that can be safely radiated as heat, expressed in watts.

The second rating on the chart, the Ft, concerns the frequency limit of the transistor. "The frequency at which the small-signal foward current transfer ratio extrapolates to unity", the manuals claim. Translated, that's the frequency at which no gain can be realized from the transistor. Of course, we are concerned with frequencies well below this rating, for in the interests of economy a transistor *rf* stage should have reasonable gain, hopefully at least 8 or 9 db. Exactly how far below this frequency the transistor will operate at a moderate efficiency is often difficult to judge.

This "highest practical frequency" depends mainly upon the percentage of efficiency wanted. The 2N2102, for example, has an Ft of 120 MHz, but 50% efficiency cannot be obtained in operation above 10 MHz. Output *is* possible above 10 MHz, but the low efficiency involved makes it impractical from the technical standpoint. At the same time, other transistor types with similar Ft's can operate well above 10 MHz with 50% efficiency. For most HF types a figure of ten percent of the Ft gives a rough estimate of operating frequency. Further specifications of the types listed on the

chart, often including practical frequency limits, can be found in manufacturers' guides and manuals. More on obtaining these later.

Assuming that a transistor running class C well below its Ft has a 50% efficiency (which, in most cases, is true), it is obvious that the dc power input of the transistor can safely exceed the Pt. In fact, at 50% efficiency, the dc input can be as much as *twice* the rated Pt. This should be apparent, for if half (50%) of the input is "lost" as output, the remaining half can be safely dissipated.

There is one major disadvantage to increasing a transistor's dc input beyond the rated Pt. If, for some reason, the antenna or load shorts or opens, destruction of the transistor is likely. Having a power input above the Pt and no means of power output, secondary breakdown would take place in the transistor, and failure would be immediate. For the sake of safety most transistor circuits are designed to have the dc power input not exceeding the Pt rating of the transistor. For then, even if the load is interrupted or shorted, the transistor will still be capable of dissipating the entire input.

Another caution concerning maximum power input considers the effect of heat on the transistor. Most Pt ratings are rated at a case temperature of 25° C, or about 77° F. Higher temperatures rapidly reduce the effective Pt. At 30° C, or about 86° F, some types lose as much as 75% of their rated Pt. Although room (ambient) temperatures usually won't be this high, the heat generated by the transistor itself can easily raise the case temperature above 35° C. As the temperature rises the transistor becomes incapable of dissipating the unused input, and thermal runaway takes place.

Destruction of the transistor by thermal runaway can be prevented by the heat sink. With an effective surface area much greater than the transistor's case, the heat sink can radiate enough heat to maintain a safe case temperature. It is important to remember that the heat sink is not meant to *increase* the Pt above its rated value, but only to allow the transistor to dissipate heat and still be capable of its full Pt.

Manufacturers:
MOT: Motorola
GE: General Electric
TI: Texas Instruments

If more than one manufacturer is shown, price indicated is the lowest, and manufacturers are listed in order of increasing price.

Type	Pt W	Ft MHz	Mfg.	Remarks, Features, Similar Types
2N706	1	200	MOT, GE, TI	Very popular HF/VHF osc. and low power amp. TO-18 case. Similar: 2N706A, 2N706B, 2N708
TIS44	1	200	TI	New "Economy Model," plastic case. Similar to 2N706
TIS48	1.2	500	TI	"Economy Model," plastic case. Excellent for VHF. Similar: TIS45, TIS46, TIS47, TIS49, TIS51, TIS52
2N697	2	100	MOT, TI, RCA, GE	One of the earlier rf transistors. Slightly outdated for rf use, but still useful and inexpensive.
2N1491	3	380	RCA	HF/VHF amp. Similar, more power and cost: 2N1492, 2N1493
2N2218	3	250	TI, MOT, GE	Similar, same price: 2N2218A, 2N2219, 2N2219A
2N3118	4	250	RCA	1 W out on 50 MHz.
2N2102	5	120	RCA	HF osc. and amp. Good performance to 10 MHz. High voltage (Vcbo=120V) and tolerant of current surges. Economy version: 2N2270
2N3053	5	100	RCA, MOT	Low cost HF to 10 MHz. Similar: 2N2405
2N3866	5	800	RCA, MOT	One of the best values available for VHF/UHF osc. and amp. 1 W out on 432 MHz.
40392	7	100	RCA	Useful to 12 MHz. Special flanged case
2N3553	7	500	RCA, MOT	Popular HF/VHF power amp. and UHF osc. 3 W out on 144 MHz. Similar: 40280, 40290
2N2631	8.75	200	RCA	An easy 7.5 W out on 50 MHz.

The Circuit

Efficient, clean-sounding transistor *rf* begins in the oscillator. Remember one basic rule: the transistor oscillator is a low power device. Tube tricks, such as 40 watt oscillators, just don't work with transistors. As the power to the oscillator is increased, clean keying and frequency stability are quickly lost.

Shown in Fig. 1. is the typical Pierce transistor crystal oscillator. Two components are of note, base bias resistor R1 and collector tank L1. R1 should be selected for the best keying characteristics. A 5K or

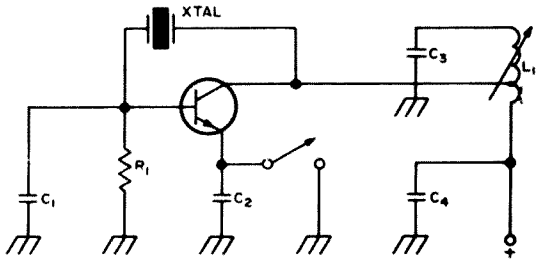


Fig. 1. Typical Pierce crystal oscillator circuit. C_1: feedback capacitor; C_2, C_4: rf bypass capacitors; C_3; output tank capacitor; R_1: base bias resistor (see text); L_1: output tank coil (see text) usually ferrite.

10K pot can be wired in during initial experimentation, adjusted, measured, and then replaced with the nearest fixed-value resistor. The value will usually be in the vicinity of 3K. Values shown in published circuits will seldom require adjustment. L1 should similarly be tuned for the highest output that is consistant with good keying and stability. Even if the oscillator will not be keyed, as in a SSB rig, these adjustments should improve stability.

Stable oscillation in vfo circuits is more difficult than in the simple crystal oscillator. The cost, though, of a simple vfo compares with the price of a few rocks, and the versatility of variable frequency is well worth the extra effort. The Clapp circuit is almost universally used, and for best stability should be well shielded. Many fine vfo designs have appeared recently in 73.

The vxo, or variable frequency crystal oscillator, is a good compromise between the crystal oscillator and the vfo. Shifts up to 25 kHz are possible from a single crystal with rockbound stability.

The simplicity of the typical transistor driver stage is yet another good reason for low oscillator input. Fig. 2 shows all that is actually necessary – an extra tank circuit, transistor, bypass capacitor, and bias resis-

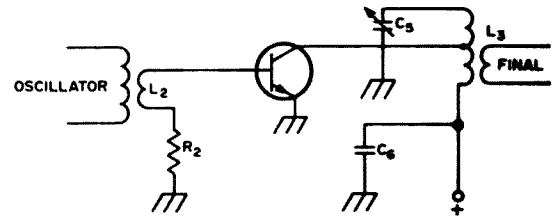


Fig. 2. Typical transistor driver stage. L_2: oscillator link; L_3: output tank coil (see text); R_2: base bias resistor (see text); C_5: output tuning capacitor (see text); C_6: rf bypass capacitor.

tor. In many cases the bias resistor will not be needed, as many transistors are capable of efficient "zero bias" operation. If needed, its value will be very low, and a small (100 ohm) pot can be used to adjust it for maximum power output, as explained above. Unlike the oscillator tank, output coil L3 is usually air-wound for higher efficiency, necessary because of the higher power level found in the driver. Therefore, tank tuning is done by capacitor C5, also tuned for maximum power output.

The selection of the transistor type for the driver is more critical than many builders realize. A type should be chosen that is *incapable of overdriving the final amplifier.* The use of a higher power unit than necessary "cut back" to a low power level is dangerous, and often costly, as meters or lights are usually needed to monitor the drive.

Completing the *rf* line, Fig. 3 is a simple transistor final. Notable here are the paralleled transistors. While some may frown on paralleling in the output stage, it remains an inexpensive method to increase output. An attempt should be made to find two transistors of the same type with similar

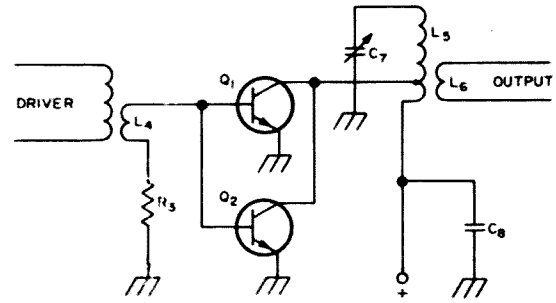


Fig. 3. Transistor output stage. L_4; driver link; L_5: output tank coil; L_6: output link; R_3: base bias resistor (see text); Q_1, Q_2: paralleled output transistors (see text); C_7; output tank tuning capacitor (see text); C_8: rf bypass capacitor.

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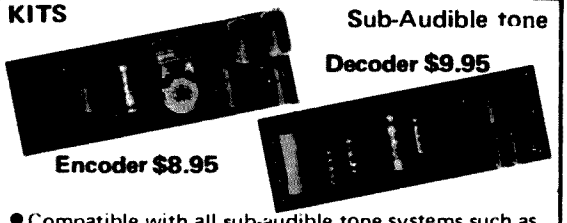
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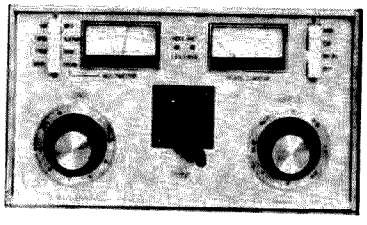
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in-circuit characteristics. Collector current, Ic, is the most important.

Link coupling is shown in the final, as in the other stages, for interstage coupling. Tapped coils can also be used, although with adjustment, links prove more effective.

Bias resistor R3 resembles the driver resistor R2, and all comments apply. This value is not critical, as the resistor serves only to raise slightly the stage's efficiency by creating class C operating conditions.

The final is almost always tuned for maximum output rather than Ic dip. C7 is simply adjusted for maximum meter or light indication, depending on the type of indicator used. The Ic should be monitored during the initial tune-up, to warn of excessive current.

See the references at the end of the article for a list of recently published transistor *rf* circuits.

Obtaining Information

Perhaps one of the most useful all-around guides to semiconductor products is the Allied Electronics Industrial Catalog. Specifications and prices are given for thousands of current types. It can be obtained free on request from Allied Electronics, 100 N. Western Ave., Chicago, Illinois 60680.

Information can also be obtained from the individual companies. Most transistor manufacturers distribute for a few cents product guides or free application notes. For several dollars complete specifications can be found in the large technical manuals.

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W1CER, "A Transistor 5-Watter for 80 and 40," *QST* June, 1967
W1CER, "50 Mc. One Watter," *QST* June, 1967
W1CER, "An Experimental UHF Oscillator,", *QST* August, 1966
K1UBA, "160-Meter 'Solid Status'," *QST* April, 1966
K6RIL, "A Stable VFO for VHF or HF," 73 November, 1966
W1JJL, "The Novice Pair," 73 December, 1966
WØTKX, "Simple R.F. Output Circuitry Design for Transistors," *CQ* January, 1966

NONLINEAR RESISTORS

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E=IR, or so Ohm's Law says, and we generally accept Herr Ohm's word for it. But there is a fairly large class of resistors for which Ohm's Law doesn't hold true: that is, for which a given voltage change *does not* cause a proportional current change. Such resistors are called nonlinear resistors.

"What, resistors that don't obey E=IR? It sounds like an enemy plot to upset our electronics defense industry," bellows the angry citrus county ham. Well, no; there's no plot; in fact, read on, old patriot. We'll see that nonlinear resistors are very useful to our electronics industry.

In a minor way, nearly every resistor is a nonlinear one. That is, every resistor has *some* variation of resistance with temperature. If current is passed through it, power (I^2R) is dissipated in the resistor, which changes the temperature of the resistor and thus its resistance. However, most resistors used in electronic circuits are designed to minimize resistance change with current, so that the assumption that each one has a constant resistance is a good approximation. The newer metal-film resistors bring the concept of a noninductive, linear resistor very close to realization.

The types of nonlinear resistors we'll be concerned with here are light bulbs, thermistors, Thyrite varistors, and similar devices. The light bulb is often called a barretter, a category which also includes small electrical fuses when used as circuit elements.

Let's take the light bulb first, since it is the most familiar to most of us. If we plot a curve of voltage versus current as was done in Fig. 1 (for a small 120V Christmas tree lamp), one immediately can see the nonlinearity of the device. The E-I plot of Fig. 1 is typical for light bulbs, and several important facts can be observed about it. The light bulb has a positive resistance coefficient; that is, as current increases, the resistance *increases*. Also, one will notice that (for normal temperature environments, where humans and electronics operate together) the greatest nonlinearity occurs at only a few percent of the normal operating voltage of the lamp.

Several other facts can be learned by more careful measurement. First, the lamp

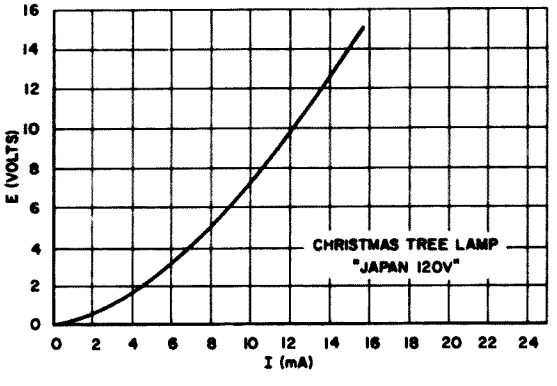


Fig. 1. A curve showing voltage versus current in a small 120V Christmas tree bulb.

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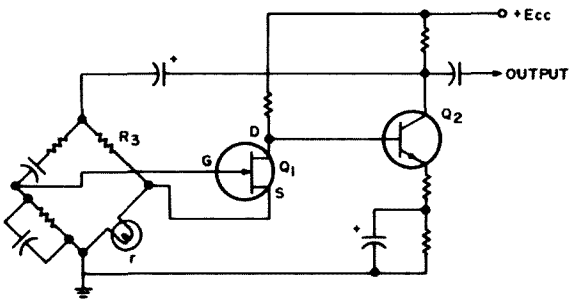


Fig. 2. The light bulb as a nonlinear amplifier as used in the Wien bridge oscillator.

has a time constant; that is, it will follow only slow changes in current. For our 120V bulb of Fig. 1, this time constant is of the order of one-half second. Secondly, at any point on the curve, if we shine a second incandescent lamp (operating at its nominal 120V) directly on the lamp under measurement, the measured current will decrease.

Perhaps the best known application of the light bulb as a nonlinear resistor is its use in the popular Wien bridge audio oscillator, as shown in Fig. 2. The left side of the bridge provides *positive* feedback to the gate of Q1, allowing oscillation to occur around this two-stage circuit. The right side of the bridge provides *negative* feedback to keep the amplitude of oscillation constant.

If the audio oscillator is initially operating satisfactorily (in class A), a change of operating conditions which increases out-

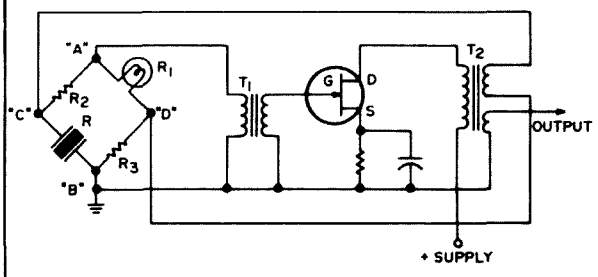


Fig. 3. A lamp as a stabilizer in the Meacham bridge crystal oscillator.

put will increase the audio voltage across R3 and r. The increase in voltage across r increases the resistance of this nonlinear resistor, which decreases the gain of the Q1 stage, restoring our original operating condition.

There is one consideration in Wien bridge design, however, that sometimes

isn't appreciated: The time constant of r must by large compared to the period of the lowest frequency of oscillation. This is necessary so that the resistance of r is only dependent on the rms value of output voltage, and does not vary at the audio

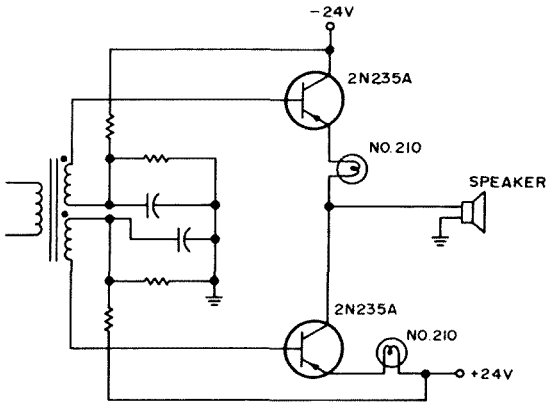


Fig. 4. Two lamps in a pseudo-complementary output stage.

frequency rate. Bulb time constant can be a problem at 10 Hz, the lower range of some audio oscillators; this is one of the reasons that (large) 120V 6W bulbs are used in many audio oscillators.

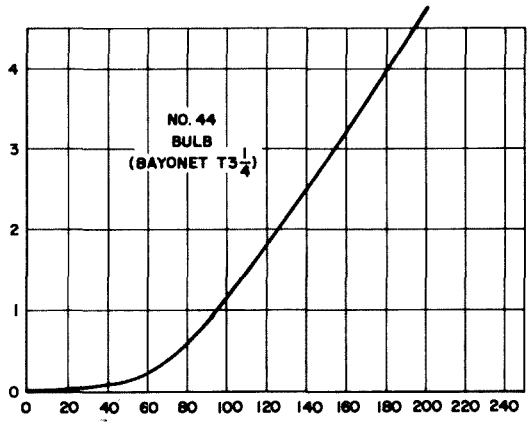
Another oscillator which uses a lamp as a stabilization device is the Meacham bridge crystal oscillator. The elementary form of the Meacham bridge is shown in Fig. 3. Since this oscillator is a narrowband device, transformers can be used for matching and phase inversion.

The bridge is balanced when the point-to-point ac voltage is zero. In perfect balance, the Meacham bridge will not oscillate. But when a slight unbalance is present, typically 1%, oscillation occurs. The lamp is positioned in the bridge in such a way that an increase in its resistance will adjust the bridge *toward* balance.

The best choice of bridge values occurs when $R=R_1 = R_2=R_3$. Since R (the series resistance of the crystal) is determined by the crystal supplier, we have very little control of this parameter. Starting with R, we must then find a lamp which offers the same resistance (R_1). The resistance R_1 must equal R at a point on the E-I curve of the lamp where resistance is changing rapidly and this value of E x I should also be approximately the value of power we expect to dissipate in the crystal in operation.

Since, in the previous two examples, the light bulb was used as a measuring device (measuring rms voltage or current), why couldn't it be used as an rf monitor? Lamps *can* be used as barretter elements at frequencies where their inductance is small compared to their resistance. The resistance of the element is then measured with an audio frequency bridge, the rf circuit (including the barretter leg) being decoupled by rf chokes and capacitors.

Because of the "loop" construction of most lamps, the inductance of a lamp is a severe limitation on usefulness at higher frequencies. The instrument fuse, however, because of its size and axial construction, is much more easily used as a barretter element. The 3AG or 8AG fuse is easily placed in a coaxial system for measurement of power. For years, standard 1/200 amp and 1/100 amp Littlefuses have served as barretter elements in power measurements up to 4000 MHz.



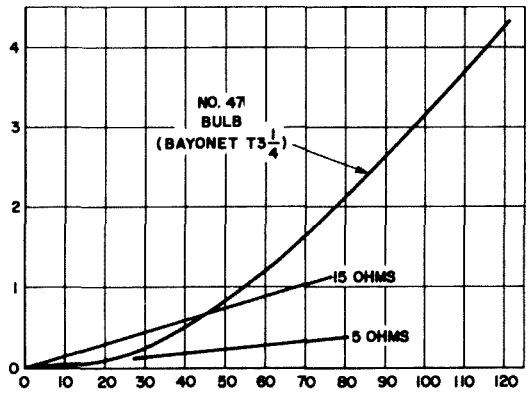
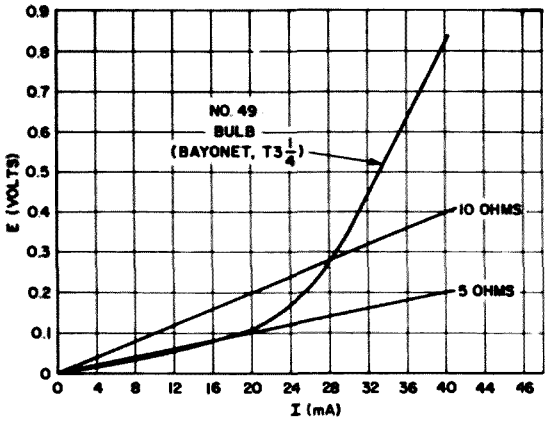
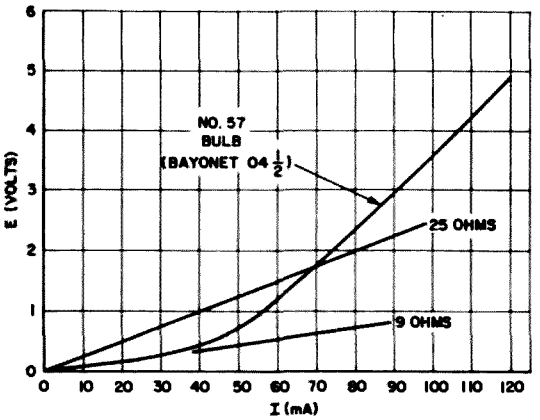


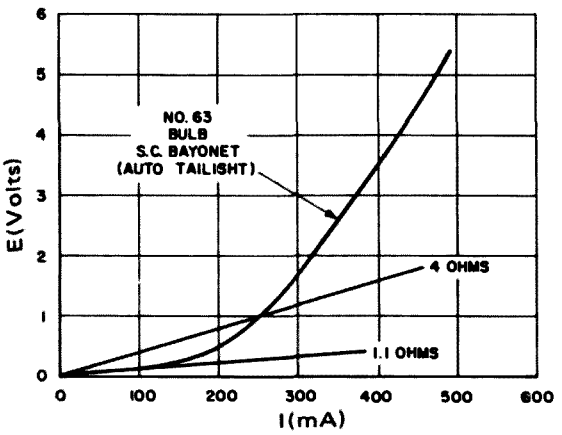
Fig. 5. A selection of E-I plots (continued on the following page).



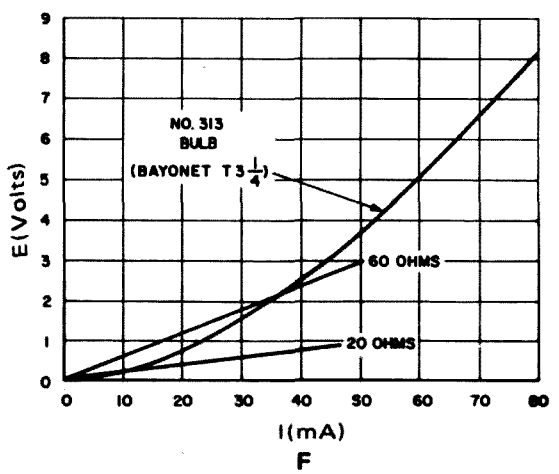
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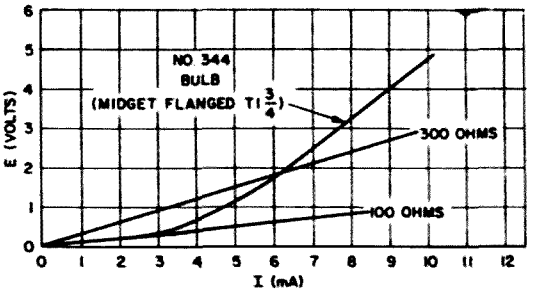
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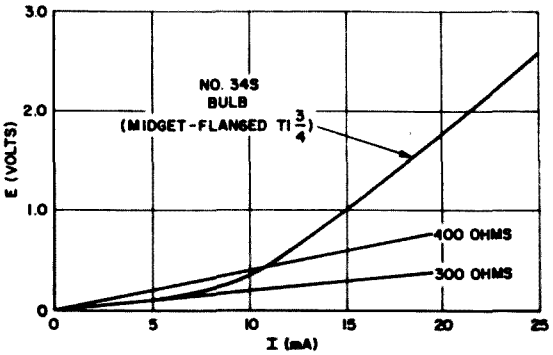
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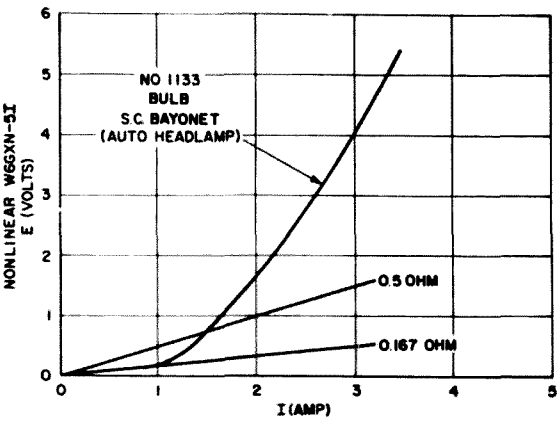
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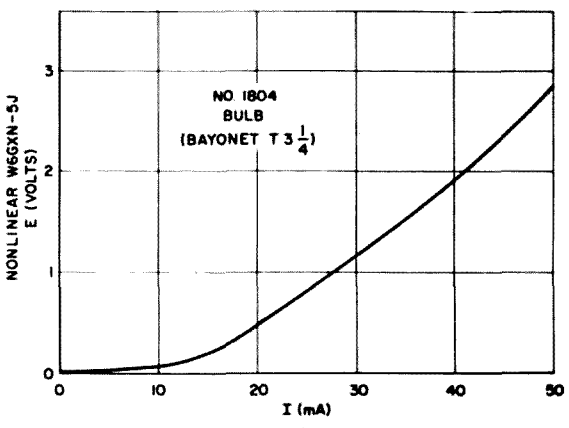
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Fig. 5. A selection of E-I plots (cont.)

So far, we have seen lamps used as stabilizing elements in oscillators and as elements in bolometers for power measurement. A similar use of lamps is in the application of current limiters or fuses. In many circuits which may be subject to expensive failures, lamps may be used to slow down destructive runaway currents, and then "open," fuse-like, if the runaway continues uncontrolled. One such application is in push-pull or pseudo-push-pull transistor output amplifiers; Fig. 4 shows two lamps in a pseudo-complementary output stage. In this particular design, separate positive and negative supplies are used, and the speaker is direct-coupled. In case of a failure of one output transistor, the speaker is protected, as one of the bulbs will open in about 0.1 second.

In order to be able to use lamps as nonlinear circuit elements, one must know, in fair detail, their E-I characteristics. E-I plots on common lamps are not generally available, and so must be plotted by the user. A selection of E-I plots is presented in Fig. 5, as measured by the author. The curves in Fig. 5a through 5j all show somewhat similar shape. The fact that some seem to display a sharper "break" in slope is apparently due to details in the form and mounting of the lamp filament.

A (rare?) exception to normal lamp behavior was found in one old telephone-style bulb. The E-I plot of this unit is shown in Fig. 6. This unit is apparently an old carbon filament type, and its response came as quite a surprise.

The curves presented in Figs. 5 and 6 should be taken as "typical" for their particular types; individual units can vary somewhat.

The second nonlinear resistor that we shall examine is the thermistor, a device not so familiar to most hams as the light bulb. Actually, there are many thermistors in use by hundreds of amateurs across the country, but they probably don't think of them as such. The thermistors generally used by hams are those which were designed for TV sets with series heater strings, but which are used in high power final amplifiers as plate parasitic suppres-



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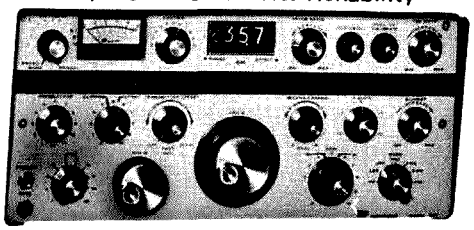


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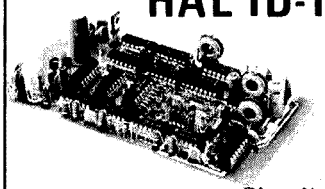
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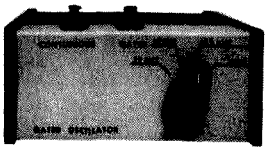
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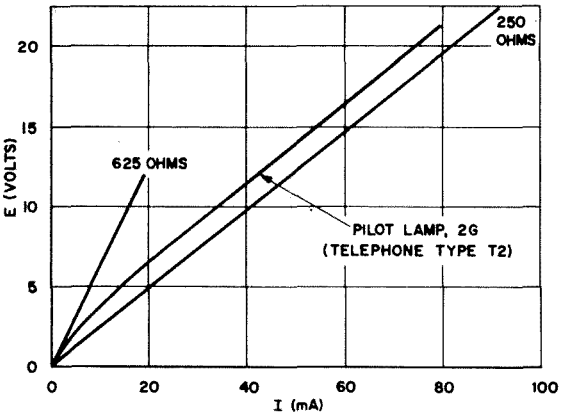


Fig. 6. The E-I plot of an old telephone style bulb.

sors. The General Cement Glo-bar type 25-912 is typical for this use, having a resistance of 20Ω hot and 250Ω cold. The variation of resistance with temperature (not with dc, since there is a coil in parallel in parasitic suppressor service) makes little difference in this application.

Thermistors – that is, thermally sensitive resistors – are made of metallic oxides of manganese, cobalt, and nickel which have been sintered at high temperature. They are ceramic-like in their physical characteristics, and they are very stable electrically. If one uses a thermistor with very small current passing through it (not enough current to dissipate a significant amount of power in the device) we find that it has a temperature versus resistance plot like that in Fig. 7. From this plot, the obvious use for a thermistor is in the measurement of temperature; and many *are* used for that purpose. The thermistor once calibrated, measures temperature by itself; unlike the thermocouple, which needs a temperature reference.

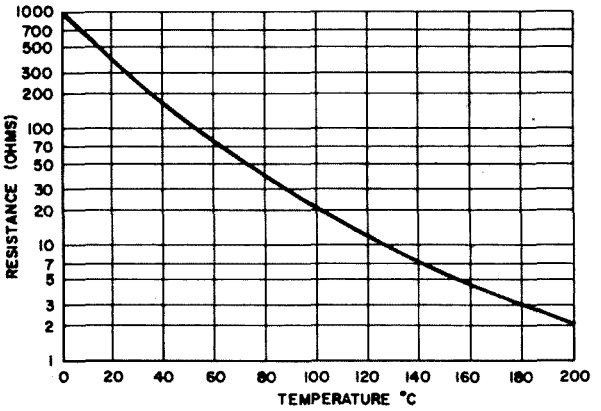


Fig. 7. The temperature versus resistance plot of a thermistor.

Temperature compensation is another use for thermistors. This can be as simple as using a low resistance thermistor in series with a relay coil to prevent its drawing too much coil current when very cold. An example of temperature compensation of a phase shift oscillator is shown in Fig. 8. Of course, the oscillator in Fig. 8 could also have been frequency-compensated with negative-temperature-coefficient ceramic capacitors.

If larger currents are used in the thermistor, so that power is dissipated in it faster than heat can be conducted or radiated away, a different situation exists. In this case an E-I plot similar to Fig. 9 applies. To the right of Vm, in Fig. 9, the thermistor has a negative resistance coefficient, due to the heating effect of current. In this negative slope region, thermistors may be used in circuits as nonlinear resistors having the opposite slope as lamps.

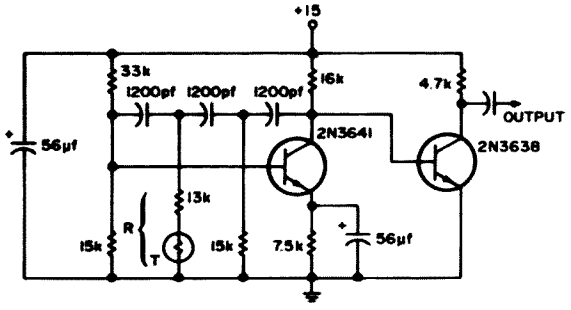


Fig. 8. Temperature compensation of a phase shift oscillator.

In Fig. 2, if R_3 is made a thermistor and r is replaced by a common resistor, the Wien bridge oscillator can be made to work just as well as originally. Since thermistors which are generally available have time constants of one second up to several minutes, the requirement that the nonlinear element in the Wien bridge respond only to the rms value of audio oscillation is easily met.

The Meacham bridge crystal oscillator (Fig. 3) is also operable using a thermistor in the lamp leg of the bridge (R_1), if one also reverses the sense of either transformer in the circuit.

Like lamps and fuses, thermistors are used as barretters for the bolometer method of measurement of radio frequency power. The thermistors used are very tiny, so have little inductance and fit conveniently into transmission lines.

Vacuum tubes have heaters or filaments that behave similarly to lamps as to their E-I characteristics. That is, until a tube heater or filament comes up to a visable red or orange color, its resistance may be only a fraction of its nominal value. This means that when we plug in our tube-type receiver, the initial current drawn from the line may be several times the normal operating value. Since the thermistor has the opposite (E-I) coefficient to the tube, one is often put in series with the line to limit initial inrush current. This is especially true in series-heater TV sets, where the previously mentioned General Cement 25-912 is used. Not only is inrush current limited by such a thermistor; but since the tubes warm up much more slowly, the tube heaters are subjected to far less thermal stress, resulting in better tube life.

Thermistors are not *special* or *rare* devices; being made by GE, Veco, Fenwal, Ferroxcube, and others. Several manufacturers' types of thermistors are obtainable from Allied Radio's mail order service, making them available easily anywhere in the U.S.

The last type of nonlinear resistor we will cover is the Thyrite varistor. This element is rather an old one as electronic devices go, having been introduced about 1930. The Thyrite varistor was first developed for use as a lightning arrestor, and is a relative of the coherer – that ancient detector of waves in the ether.

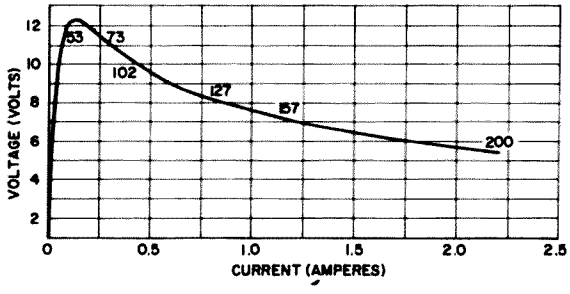
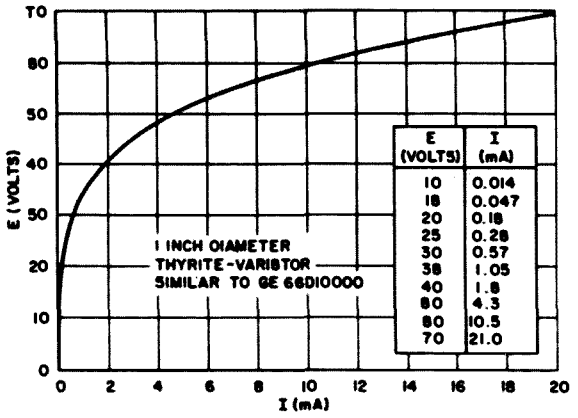


Fig. 9. The E-I plot of a thermistor using larger currents so the power is dissipated faster than heat can be conducted away.



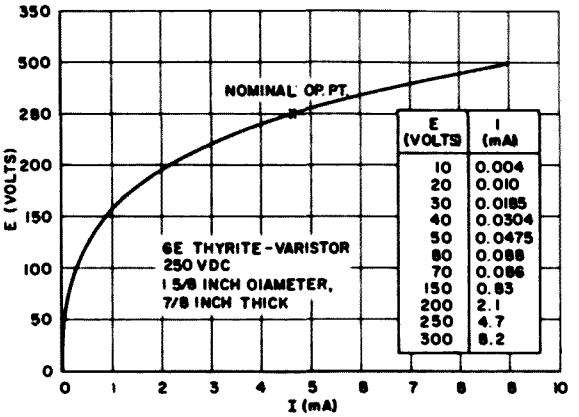


Fig. 10. The E-I plot of a Thyrite varistor.

Thyrite displays a negative coefficient of resistance versus voltage, like a thermistor, but differs in a very important way. The resistance value of the Thyrite varistor does not take seconds or minutes to be established, after application of voltage. This means that the Thyrite varistor fills the need for a "fast" limiter, one which will respond at the ac rate. This fast response shouldn't come as any surprise, since the stuff *was* designed for lightning!

Figure 10a shows an E-I plot of a representative Thyrite varistor, and Fig. 10b shows another higher-voltage type. Both curves show identical curvature even though the plots have quite different scales. This agreement is due to the fact that Thyrite follows the relation $i=Ae^{3.54}$. What this means, simply, is that if one doubles the voltage across *any* piece of Thyrite, the current through it will increase roughly twelve times.

Thyrite is useful any place we wish to attenuate transient voltage spikes, whether they come from the ac line or are internally generated by circuit components. For example, Thyrite varistors are widely used across relay coils to control the inductive spike that occurs when the relay is deenergized.

Figure 11 shows a simple power supply that uses three of the Thyrite varistors of Fig. 10a to protect the rectifiers. The two varistors across the transformer secondary are to protect against transients that are coupled from the ac line. The third varistor is to damp the inductive spike which occurs when the supply is turned off and the choke field collapses. These particular Thyrite varistors have been used extensively by the author because of their convenient size, voltage rating, and *low price*. They are available for 49 cents from Red Johnson Electronics, 3311 Park Boulevard, Palo Alto, California (who also sells the 16 VA transformer shown in Fig. 11 for $1.89). The fully protected supply can thus be built for about $10.

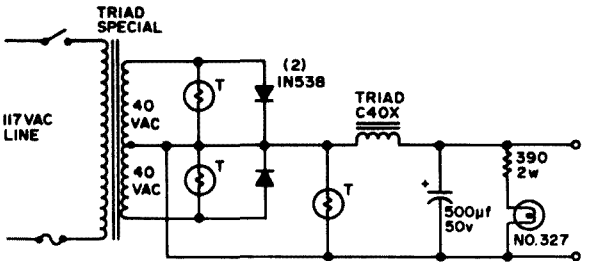


Fig. 11. A simple power supply using three Thyrite varistors to protect the rectifiers.

Like thermistors, Thyrite varistors are available through the Allied catalog and so can't really be considered *odd* devices. Although Thyrite varistors are historically old devices and are somewhat bulky, their use costs little and can save many dollars worth of expensive semiconductors.

Bibliography

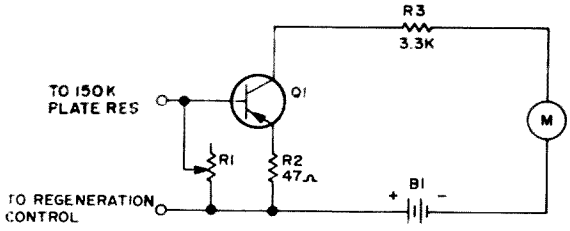
1. Olson, H. "The Wien Bridge Oscillator," *73 Magazine* 1967.
2. Terman, F., and Pettit, J., *Electronic Measurements*, McGraw-Hill, 1952, p. 45.
3. Victory Engineering Corp., "Handbook of Thermistor Applications," 1963.
4. General Electric, "Thermistor Manual," 1956.
5. McEachron, "Thyrite: A New Material for Lightning Arresters," General Electric Review; Vol. 33, No. 2, Feb. 1930.

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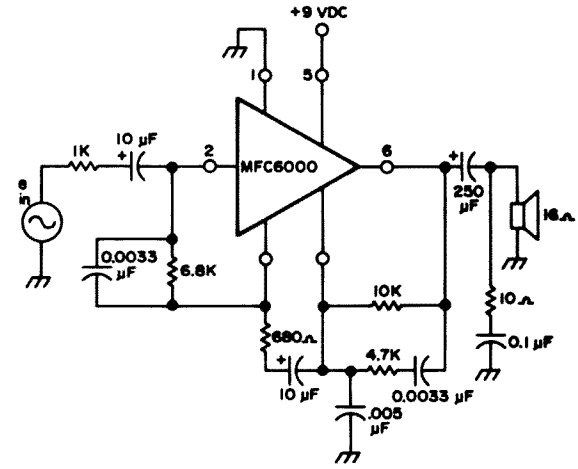
CIRCUITS, CIRCUITS, CIRCUITS...

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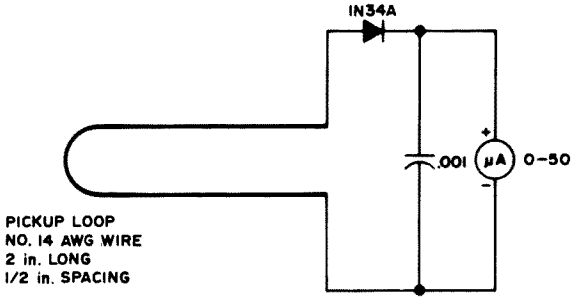
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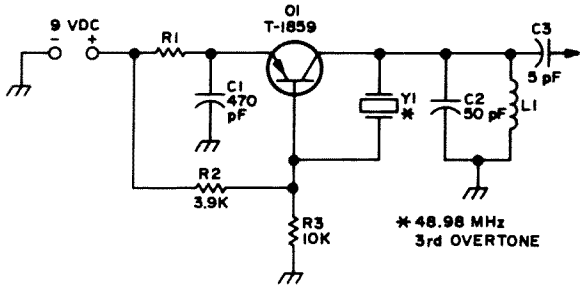
S-meter for the "Sixer," from 73, July, 1961, designed by K5VMC. The circuit is applicable to the "Tenner" and "Twoer" as well. It consists of an inexpensive 0–1 mA meter and a single transistor meter amplifier. Half-scale deflection is obtained on a signal strong enough to quiet the background hiss as compared to about 1/4- to 1/3-scale on a 20,000 ohms per volt meter or a VTVM reading the voltage drop across the plate dropping resistor.



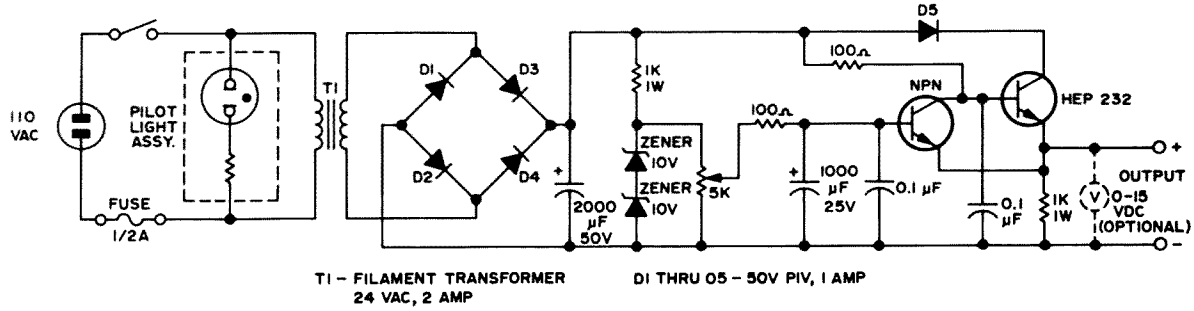
Motorola MFC6000 monolithic functional circuit, in an audio amplifier application. Circuit courtesy of Motorola Functional Circuits catalog.



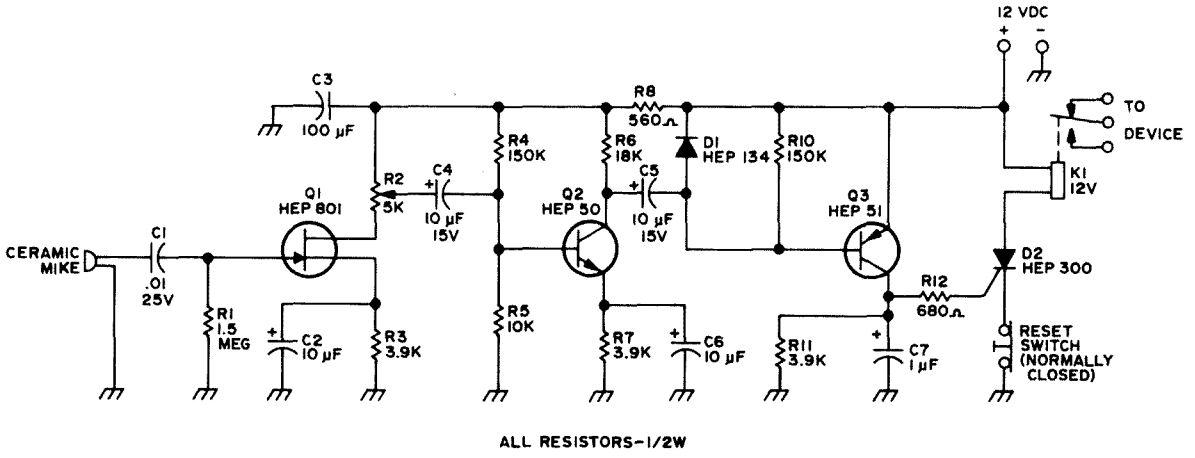
RF Sniffer designed by W5JCB, from an article by K5JKX in 73 Magazine, December, 1960.



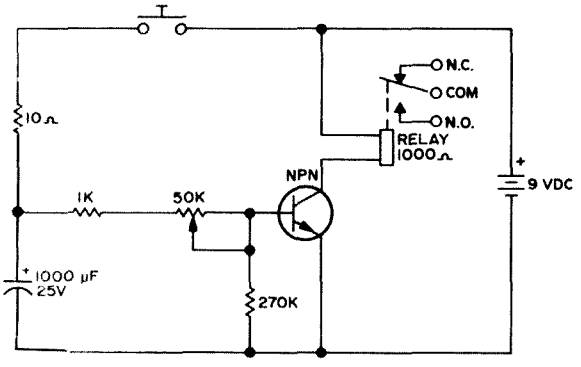
Crystal oscillator for aligning receivers, reprinted from FM Magazine in FM Anthology I, available from 73 Magazine for $3.00.



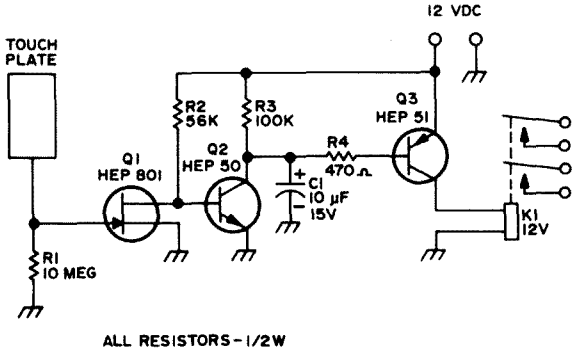
Power supply for 0–20 volts up to 1A. Run that tape recorder, transistor radio, pre-amplifier, or charge a battery. Circuit courtesy Calectro Handbook (50¢), 400 S. Wyman, Rockford IL 61101.



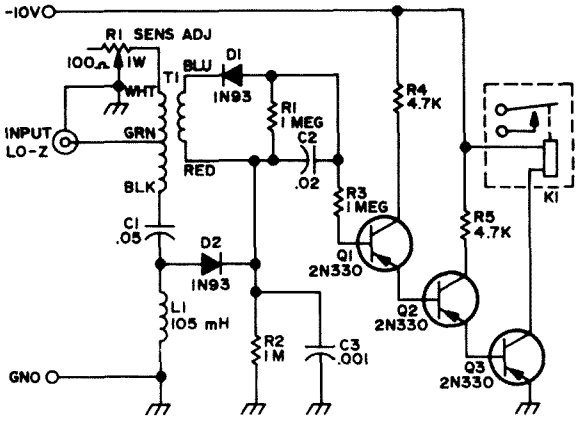
Sound activated relay. Control any circuit with a clap of the hands or any sharp sound. The circuit remains activated until manually reset. It has adjustable selectivity. Circuit courtesy Motorola HMA-33 "Tips on Using FET's."



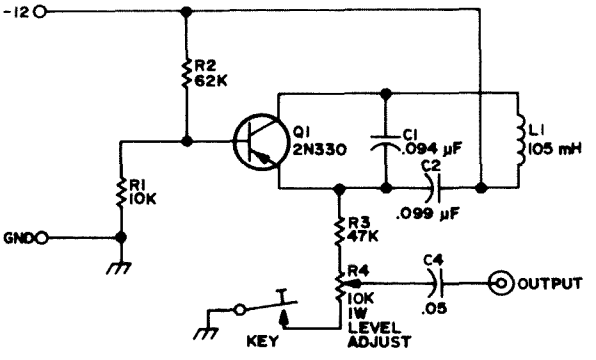
Timing switch, 10 to 100 seconds. No off switch needed since circuit draws only 1 µA when not used. Great for darkroom, 10 minute timer for identification, repeater shutdown for windy talkers, etc. Q1 is a Calectro K4-506 transistor. Circuit courtesy Calectro Handbook.



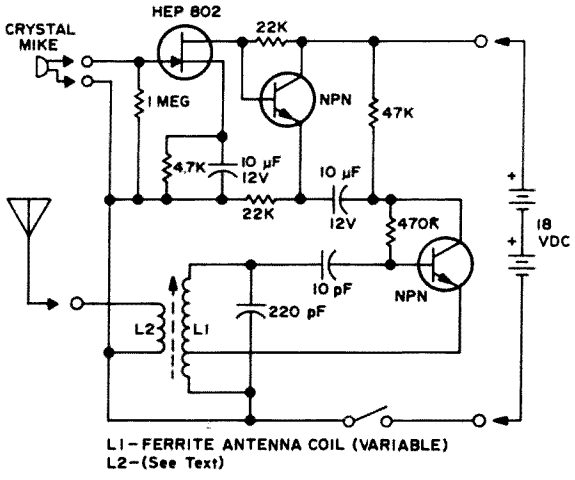
Touch switch. This switch is operated by body capacity . . . just touch the plate to operate the relay. How about this to turn the rig on and off? You can use a latching relay, time delay relay, stepping relay, to do just about anything. Circuit courtesy Motorola HMA-33 Tips on using FETs, available free from Motorola, Department 73, Box 20924, Phoenix AZ 85034.



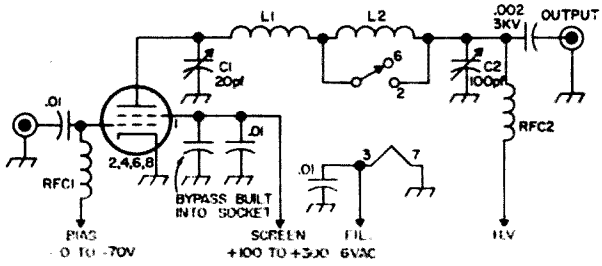
This single-tone decoder has a high degree of selectivity, stability and reliability. Designed by Bob Mueller K6ASK, it and its companion encoder below appeared in FM Magazine in January, 1968. The article is reprinted in FM Anthology I, published by 73 Magazine.



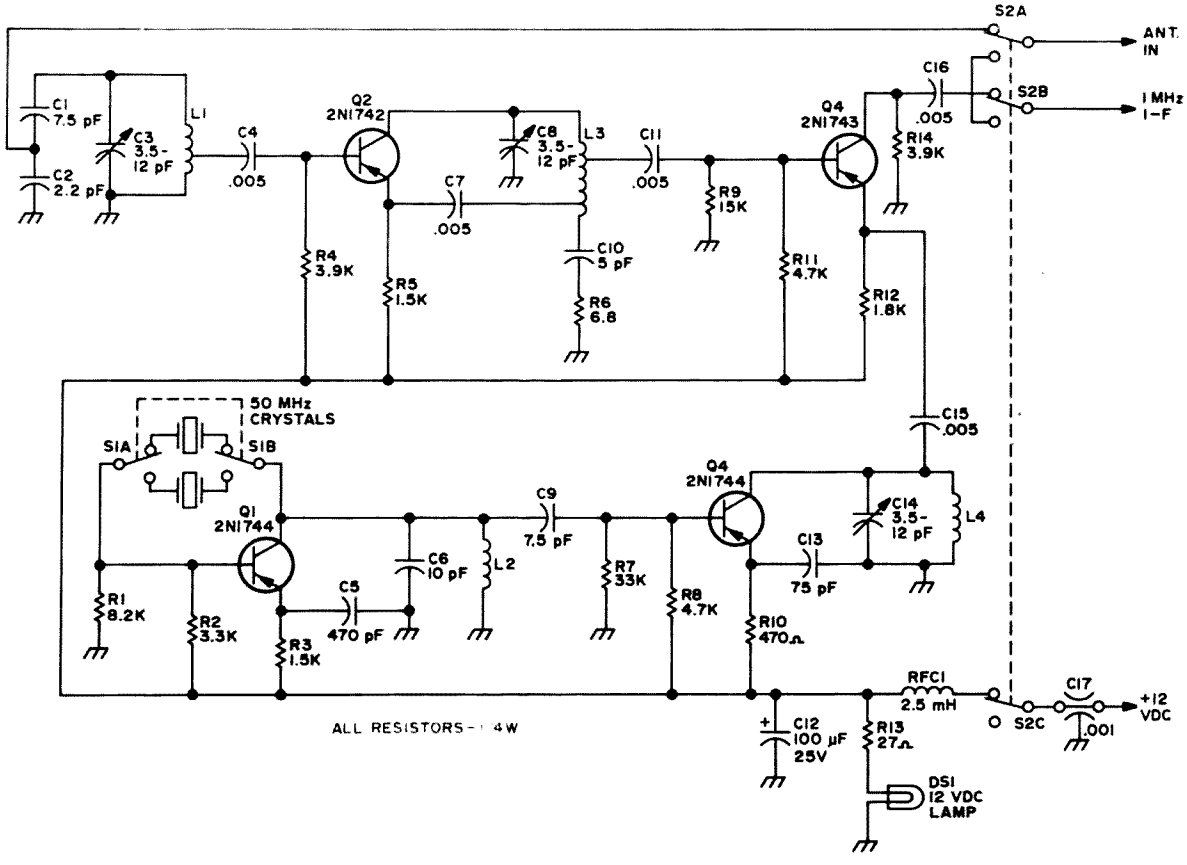
K6ASK single tone encoder (see above).



AM wireless transmitter. Useful for baby-sitting, sick watch, intercom, and plenty etc. Circuit courtesy Calectro Handbook. L1 is a variable antenna coil, ferrite, Calectro D1-841. L2 is four turns of hookup wire wound on top of L1. Q2-3 are NPN silicon transistors Calectro K4-507.



4CX250 amplifier for six and two meters, using single pole switching. By K1CLL, from 73 Magazine, April, 1966. Simple modifications by Fritz Hervey K4ETZ [forget the 6 meter coil and use smaller PA tuning capacitors, Class C bias and a grid tank] allow 10W drive, 200–250W out with enough air on the anode. Amplifier should have a screen clamp tube with G2 supply bled down from high B+ for best results, says Fritz . . . and he suggests a TV power transformer with a doubler for cheap 1.2–1.5 KV power.



Car radio converter, by WA8ALL, from FM Magazine, June 1967, reprinted in 73's FM Anthology I. There's no text or anything with the original, either. . .just the circuit.

REPEATER BULLETIN

As a reader of 73 you may be interested in the newest FM bulletin . . . the Repeater Bulletin. This magazine is published by 73 Magazine just for the users of repeaters, particularly in the New England and Eastern New York areas and it carries news of activities of the repeaters covering this section of the country.

In addition to news from the repeater clubs the Repeater Bulletin will carry maps showing the coverage of the repeaters, discussions of the problems faced by repeater groups . . . discussions of frequency coordination, of functions being added to repeaters, of whistle-on, of tone burst, of touchtone, and continuous tone coding and decoding . . . antennas . . . coverage of repeaters . . . hints for mobile installations . . . cross-band links . . . circuits of value to both users and repeater owners . . . a bibliography of the articles being published on FM . . . discussions of new equipment being brought out . . . ideas for repeater development . . . new frequencies . . . 220 plans and developments . . . 450 repeaters and their problems . . . problems faced by FMers in other areas of the country worthy of consideration in the North East . . . news of club meetings . . . symposiums . . . conventions . . . dinners . . . auctions . . . swapfests . . . and other social events . . .etc.

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If the Repeater Bulletin is successful, it is always possible that its coverage may be extended to cover more of the country or that other regional editions could be published. We have all of the facilities here at 73 to turn out publications such as this quite economically, so we may be able to provide a communication medium if it is needed in other areas.

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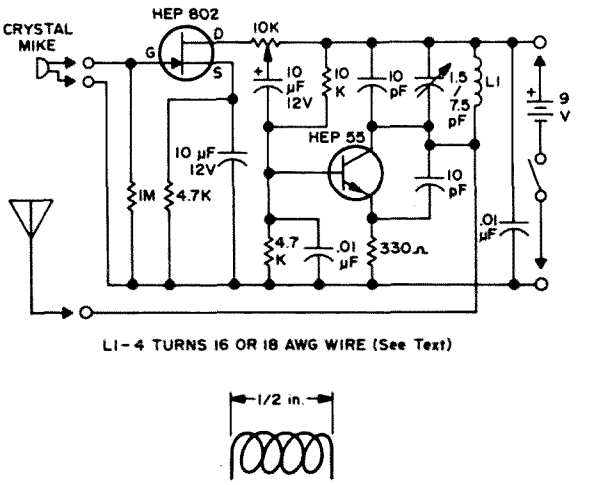
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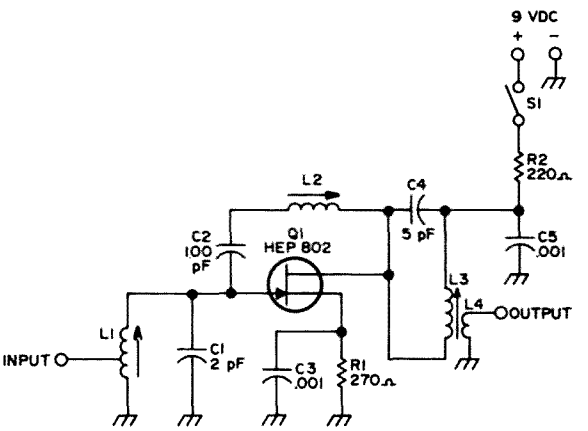
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REPEATER BULLETIN PETERBOROUGH NH 03458



FM wireless transmitter (88–108 MHz). Might be used for bugging a room or something like that. Circuit courtesy Calectro Handbook. C7 is a short length of twisted hook up wire about 1/2 inch long. L1 is four turns length about 1/2 inch and 1/4 inch dia. Careful with this one, it can cover a lot of territory!



L1 - 5-1/4 TURNS, TAPPED AT 1-1/4 TURNS, NO. 26 AWG WIRE.
L2 - 9-1/2 TURNS, NO. 34 AWG WIRE.
L3 - 5 TURNS, NO. 26 AWG WIRE.
L4 - 1-1/4 TURNS, NO. 26 AWG WIRE, AT LOW END OF L3.

ALL RESISTORS - 1/2W.
ALL CAPACITORS - 10V.

NOTE: ALL LEADS SHOULD BE KEPT AS SHORT AS POSSIBLE (PC BOARD IS RECOMMENDED)

Two meter preamplifier. Very few receivers will not be improved with a preamplifier such as this. The coils are wound on Miller #60A022-4 forms, or any other small brass slug ceramic forms. A PC board is recommended. Circuit courtesy Motorola HMA-33, Tips on using FETs.

Neil Johnson W2OLU
74 Pine Tree Lane
Tappan NY 10983

SIMPLE DIODE CONTROLLER

Some time ago I had a problem with the night light in my entrance hall. The little bulb kept burning out. The next step was to install a larger bulb. This was not too bright. About this time, I pulled the Variac from the workbench and determined what constituted a satisfactory setup. But it seemed foolish to keep a 1 kW Variac tied up in controlling less than 10W of power. The simple circuitry used in the solution to the problem should appeal to the reader, not only for light control, but for many other ac-dc applications. Light control, soldering iron heat control, and speed control for small universal ac-dc motors are but a few examples.

Most experimenters are acquainted with the fact that with a small current load, the dc output of a capacitor-input type of filter will soar to relatively high voltages. Advantage is taken of this fact in the simple circuit under discussion. The circuit, shown in Fig. 1, has only seven parts: three capacitors, three inexpensive slide switches, and a silicon rectifier. Cost for the whole thing? Three or four dollars, if you buy all new parts.

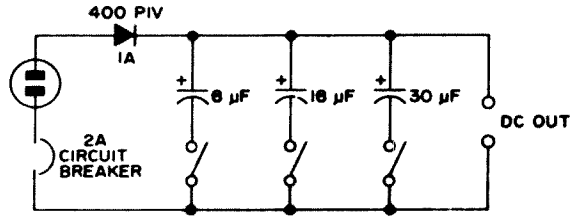


Fig. 1. Schematic diagram.

A diode will rectify the ac at 120V and convert it to pulsating dc. Due to a small loss through the silicon rectifier, the output voltage will come out close to half of what is fed into it. If the ac is 120V, the pulsating dc will be close to 60V. When read on a dc voltmeter, the true DC voltage will be roughly 54V (60V due to half-wave rectification x 0.9). If this voltage is then applied to an incandescent lamp, the actual input wattage will be approximately 25% – that is, half voltage at half current. I say "roughly 25%" since my calculations have been simplified and do not include

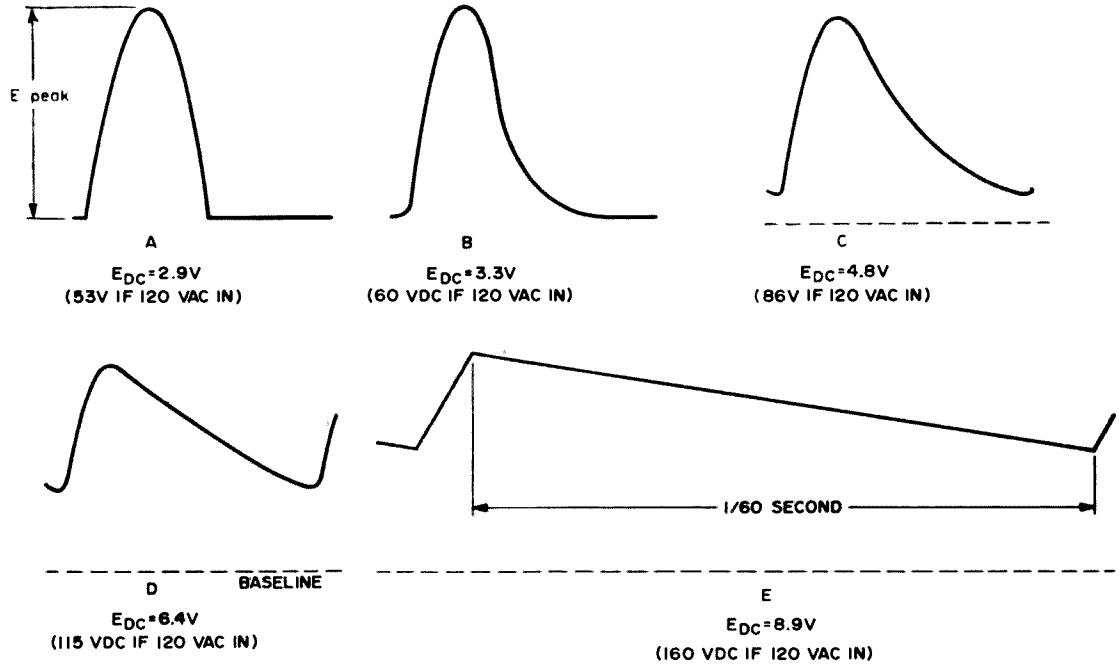


Fig. 2. NOTE: These waveforms and dc voltages shown are for purposes of illustration only. The actual dc output voltage from the unit diagrammed is much higher, running from a minimum of 53V to a theoretical maximum of 168V dc when fed with 120V. These CRO pix illustrate how a condenser-input type of filter will give more "boost" with varying amounts of capacity when feeding a fixed load.

the resistance-vs-temperature factor of the tungsten filament. If we introduce a small capacitor at the input to the filter, this will boost the pulsating dc output voltage slightly. The actual voltage will depend principally upon the size of the filter capacitor and the current requirements of the load being supplied. Through the application of three capacitors of 8, 16, and 30 μF, we can obtain eight discrete steps throughout the range of the controller. That is, we can use the output of the silicon rectifier with 0 - 8 - 16 - 24 - 38 - 46 or 54 μF of input capacity. This will give a wide range of control for small loads, any nonreactive type of load, up to a maximum of 50W with the normal line voltage of 120V ac being fed into the input. Strictly ac types of electrical equipment, such as a transformer, cannot be fed from the controller, since the output voltage is pulsating dc.

A look at the oscilloscope will show how this variation in voltage is effected. In Fig. 2 the unaltered half-wave of the rectified and unfiltered dc shows above the baseline. As more capacitance is added across the rectifier output, the valleys between the alternate pulsations of dc start to fill in. A close examination of the last CRO presentation will reveal that the rectified dc pulse does not return to the baseline, where it would touch zero. Instead it remains at a much higher average level, due to the storage effect of the capacitors.

With a 120V ac input, this would amount to 169V. For this reason, it is always wise to start the controller with zero capacity, and then add small increments of capacity. When the characteristics of a particular load become familiar, the controller may be turned on to a predetermined setting.

My main use for this simple controller is the setting up of certain light intensities, plus heat control for a small soldering iron. There are no theoretical limits for a device of this nature, but economic realities limit its function to controlling powers up to 50W. Beyond that range, other devices begin to come into their own. However, the simple diode controller does a very effective job up to 50W or so, and does so with low cost and simplicity.

. . .W2OLU■

H. P. Fischer VE3GSP
1379 Forest Glade Road
Oakville, Ontario

Some Harmonic-Suppression with a Low-Pass Filter

or

How to Eliminate THE Major Source of TVI

TVI is predominantly caused by radiated harmonics. Particularly the 14, 21, and 28 MHz bands cause harmonics that fall into TV channels 2–6. This was my problem also and it was fairly easy to cure it.

I was stuck with TVI a long time because most literature listed several sources of TVI and I was not able to classify my source. As for remedy, I didn't want to spend any money on a trial-and-error basis. But eventually, it became obvious that the problems were antenna-radiated harmonics, and that the cure would be a low-pass filter.

To make triple-sure, I borrowed a grid-dipper and fiddled myself a standard pick-up coil, which I hooked up to my dummy load. Then I tuned the spectrum while I switched to 10, 15, and 20m bands. And there they were – harmonics. 57 MHz, 63 MHz, 85.5 MHz. And when I checked the TV channel frequencies, I really understood why I had to have TVI. I estimated the power level of my harmonics by switching my pickup coil over to a little transistor oscillator, on 27 MHz, which puts out 30 mW, rf. This indicated that my harmonics at 57 MHz were 5–15 mW on

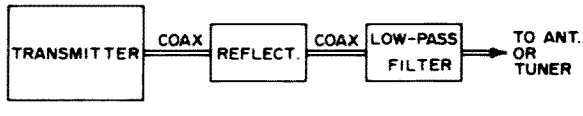


Fig. 1. Diagram of filter set-up.

14 MHz and 15–30 mW on 28 MHz. This would be 35–45 dB down compared to my transmitter output, which is 100W. I looked through the specs of a few transmitters in this price and power bracket and found specs to read around –40 to –45 dB for harmonic suppression. So I was in the ballpark with my measurements.

The Filter

Surprisingly, none of the handbooks emphasized the urgent need for a low-pass filter to eliminate harmonics that go to the antenna. One would expect this to be just as standard as the transmitter itself. After I obtained my results on the cause of my TVI, I purchased a good quality low-pass filter. Good design, I should really say, because it has a few features that are essential if you want the filter to work efficiently – and which not all available low-pass filters have.

Two most essential tuning adjustments are the input- and output-impedance adjustments which are an asset if you want to avoid excessive power loss on transmitting and receiving. (See Fig. 1 for schematic.) Another important feature is the three tuning adjustments for channels 2-3-4, 4-5-6, and 7 & up. The filter manufacturer claims a suppression of 70 dB minimum for frequencies of 45 MHz and higher. This put my harmonics from 40 dB down to 110 dB, which is about 1 nW in my antenna. It eliminated all my TVI problems except for channel 2 on my own set, but then – my TV antenna is right below my groundplane.

This filter is a Radio Society of Ontario design and is manufactured by Taylor Communications, Uxbridge, Ontario. The price is $24.95 Canadian. It is not cheap, but it *is* effective.

How to Tune the Filter

The success of the filter depends on how well you tune it, and to do this you must have an swr bridge or some kind of reflectometer. The best way to set it up is as Fig. 2 shows. From your transmitter you should go through your reflectometer to the filter, from there to the antenna. Since the filter is designed to work in a 50–75Ω line, you have to use this type of coax for the interconnections. If you want to use a 450Ω open feeder you have to install everything between transmitter and tuner. Now, before you start tuning you also need a dummy load. With all the equipment hooked up as in Fig. 1, first adjust the input and output impedance of the filter. Tune C1 for a maximum *forward* reading on your reflectometer, tune C4 for minimum *reflected* on reflectometer. Repeat the adjustments several times. Your reflected power should be less than 1%, or below 1.2:1.

The next adjustments are to get maximum rejection of the interference frequency. To do this I turned on my TV set and switched it to the channel that I wanted to clear up. I increased the signal of the transmitter until the picture would get crossbars. Then I started to tune the related C on the filter in small increments. After each incremental adjustment I repeated the tuning procedure for CI and C4 to maintain the low swr. Since I did not have any TVI at TV channels 7 & up I simply adjusted this C5 for maximum *forward* deflection.

After tuning the filter according to this procedure, I eliminated TVI on channels 3, 4, 5, 6; only 2 remains somewhat a problem in my own house. Neighbors of mine who had TVI before do not have any at all. One chap with a color TV can merely see a faint change in color on channel 2.

You will find that you might not have the optimum filter setting when optimizing for one particular frequency. In my case, when tuned for 20m I found swr tuning was not quite maximized on 15m and somewhat more off on 10m. I set my filter

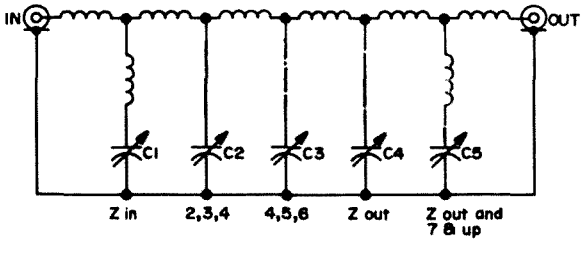


Fig. 2. Schematic of filter.

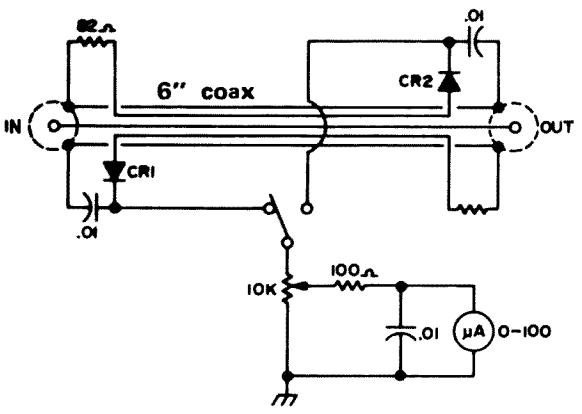


Fig. 3. Schematic of reflectometer. CR1 and CR2 are any matched pair of silicon or germanium diodes.

to compromise between the 3 bands. With a dummy load, reflected power on a compromise setting reads between 1 and 2% depending what part of the bands I use. Switching to my groundplane antenna, I am getting between 2 and 6% power reflected.

The Reflectometer

The reflectometer I used (Fig. 3) is a modified version, as the one listed above. As a conductor and pickup I used 6 in. of RG-8/U coax with two insulated wires pulled into the braid. This is less of a mechanical job than the original of W4BRS (73, Sept. 1967). As for the meter scale, I also calibrated it in "% reflected." This is more meaningful to me than swr.
Dial calibration based on a 100% meter scale:

Scale %	= SWR	= % reflected power (coax losses disregarded)
9	1:1.2	.8
20	1:1.5	4.0
33	1:2.0	10.5
43	1:2.5	18 5
50	1:3.0	25.0
60	1:4	36.0

The Dummy Load

This dummy load (See 73, Feb. 1968, WA6OBH) was built and I found it can take 80W rf for quite some time. However, I do not advise you to use motor oil for coolant, since its dielectric constant is much to low because of inorganic additives. ....VE3GSP■

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HW 100... Adding the 400 Hertz CW Filter

Many operators like to work both CW and phone. The HW-100 is supplied with the SSB filter only. Heath states in the HW-100 manual that the CW filter can be placed in the rig, but at the cost of leaving out the SSB filter. This of course leaves the transceiver good for CW only. Many operators, like myself, operate both CW and phone, so of course I put in just the SSB filter. Being very human, I later decided it would be nice to have a narrow, 400 Hz slot for CW. This, of course, was realized after the rig was completed. I spoke with some boys who placed the CW filter into the *completed* HW-100, doing it as it is done in the SB-101. This is a herculean task in the completed rig, but it can be done.

After reviewing the circuitry, Fig. 1, and the method of mechanically performing the switching of either filter in or out of the circuit in the SB-101, I felt there must be an easier way to do it. The following modification is easier, faster to install, and *cheaper*. I spent 49¢ over the cost of the filter and a new matching panel knob.

Modification Procedure

Additional parts needed:

1. CW filter with mounting nuts.
2. Matching panel knob for HW-100.
3. Rotary wafer switch containing the equivalent of 3 SPDT contacts (Fig. 2).
4. New mounting bracket for filter. The old one can be redrilled, as I did, to accommodate the two filters as both filters are physically identical and the bracket for both filters is the same as the CW bracket alone, except for the holes being in different places.

Considering the frequent use of both filters at my QTH, front panel installation for the switching of the filters was needed. Since the mike will usually remain connected, access to the mike connector was of secondary importance.

The PTT mike connector, at hole M on the front panel, was moved to the left rear apron where the unused hole was enlarged to receive it. Additional hookup wire was used to lengthen the circuitry resulting from the move. The wafer switch was placed in the hole M. The CW filter was mounted on the filter bracket with the SSB filter. The two capacitors, C506 and C101 and the resistor R929 are not connected to the filter, only to the circuit board points as instructed in the HW-100 manual. The remaining connections of the capacitors and the resistor will be done on the wafer switch as in Fig. 2. Make sure the lugs of the phone jack at hole L does not contact the lugs on the wafer switch. Bend the lugs away as needed on the phone jack. All leads from the wafer switch to the filters will pass through grommet CA for neatness and ease of installation.

Ground connections can be made at any convenient point. R929 went to the ground foil of the modulator board. The

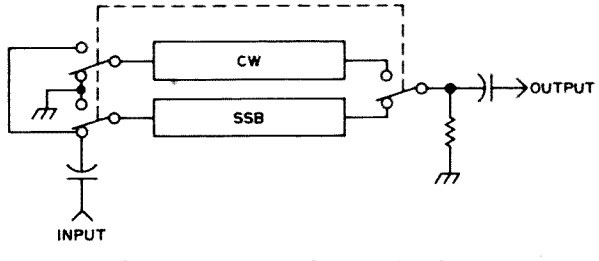


Fig. 1. Schematic for CW and SSB filters in SB-101.

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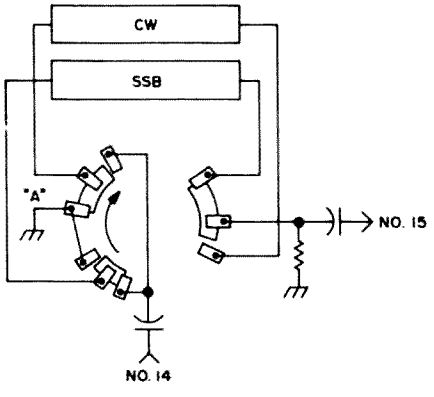


Fig. 2. Schematic/pictorial for CW and SSB filters in HW-100.

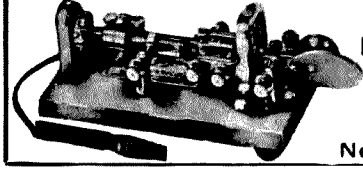
"A" ground (Fig. 2) I put to a bolt holding the modulator board to the chassis. Insulated wire was used and sleeving as needed to prevent unnecessary bare wire exposure.

I strongly suggest that if the original filter bracket is going to be redrilled as I did, that you remove the bracket from the rig, even though it means removing the VFO also. This little extra work will save a load of time, effort and possible expense in trying to find short circuits and/or resultant damaged components caused by those small bits of metal dropping into the works of the rig. Also do not try to get away with the grounding on the input side of the filter when not in the circuit. These filters have, I am told, bifilar windings. Because of the close coupling of these two filters, induced emf can be generated in the filter while not in use. This in turn will create its own field which will affect the filter in the circuit. This induced emf in the unused filter must be removed and is done so by grounding. You can count on this to hamper the filter qualities and to interfere with good receiver operation.

The advantage of this method of installation is that the front panel does not have to be pulled away from the chassis. This can be a big undertaking for the type of switching used in the SB-101 because the wires are short on the band and mode switches on the front panel of the completed rig. Besides, the purchase of the 2 slide switches and the mechanical linkages for the switching of filters as in the SB-101 will cost far more than the 49¢ I spent for my wafer switch.

. . .WA2EAW

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CQ U.S. with PHONE PATCH TRAFFIC

Ralph Steinberg K6GKX

Dial one one zero on your telephone and a pleasant voice answers, "Operator." This is nothing unusual except when a phone patch is being arranged by a long distance operator for some serviceman to talk to his family from Vietnam.

Thousands of phone patches are beamed daily to the United States by MARS stations in Vietnam. Handling thousands of phone patches takes team work; the long distance operator, the overseas radio operator, and the station in the United States receiving the overseas calls make up the team.

It is fascinating to see at first hand how these operators work the long distance switchboards. The girls have boards with switches, jacks, and plugs. Each position has nine incoming and nine outgoing circuits and each operator is responsible for these circuits. If phone patching is in operation, each operator can handle nine calls at one time. To keep the calls moving smoothly, the operator always has another ready to talk when the preceeding call is finished. Usually, on phone patch operations, one operator will stay on the circuit until all phone patch operations are completed.

All phone patch calls are not just routine and many times the operator has difficulty in locating the person to receive the call. Frequently calls are for families living in small villages in mountain areas far from a long distance phone line. The operator will try to locate the nearest long distance phone so that the phone patch can be completed. Often company officials have assisted in locating hard-to-find parties, sometimes at all hours of the night.



Fig. 1. View of long distance telephone switchboard operations. Pacific Telephone Co. photo.



Fig. 2. Phone patching at MARS station K6WAH/AA6WAH. U.S. Army photo.

A serviceman in Vietnam was calling his family, and the long distance operator advised the father that she had a collect call from his son and would he accept the call. The father refused the call thinking someone was joking until the operator explained it really was his son on the line and the father then accepted the call. It was a happy and exciting event as this was the first call the family had received since the son left home to go overseas. They were unaccustomed to receiving phone patch calls, especially collect. On other calls proposals of marriage are heard several times a day. As one serviceman proposed, the sound of guns could be heard in the background.

Drama has an equal share in the phone patching. One call from a serviceman to his wife was never completed as she was among the missing in a plane crash. There are also calls to the families by the servicemen, explaining that they have been injured, but not to worry. One serviceman was talking to his wife and asked if the new baby had been born. When he learned that triplets were born, the telephone line went dead on his end. He had fainted.

The long distance operators are exceedingly interested in the phone patch work they are doing. They, too, have sweethearts, husbands, brothers or sons in the military service, and frequently receive phone patch calls from them. These girls take their work very seriously, and even with all the thousands of phone patch calls they handle, each call has some feeling of excitement attached to it.

Most phone patch traffic from Vietnam is received on the west coast at MARS stations from San Diego, California, to Ft. Lewis, Washington. In southern California, there are more than twelve MARS stations located on Army, Air Force, and Navy installations. Many thousands of phone patches are completed each month through these stations, with additional calls being handled through radio amateurs, members of the Military Affiliate Radio System. One of the busy MARS stations in the Long Beach, Los Angeles area is K6WAH/AA6WAH at Fort McArthur, with radio operators on duty twenty-four hours a day. This station completes an average of 4000 phone patches a month.

It was not my purpose to glamorize the long distance operators, but to commend them for the fine work they are doing to keep up the morale of our servicemen.

. . . K6GKX ■

Neil Johnson W2OLU
74 Pine Tree Lane
Tappan NY 10983

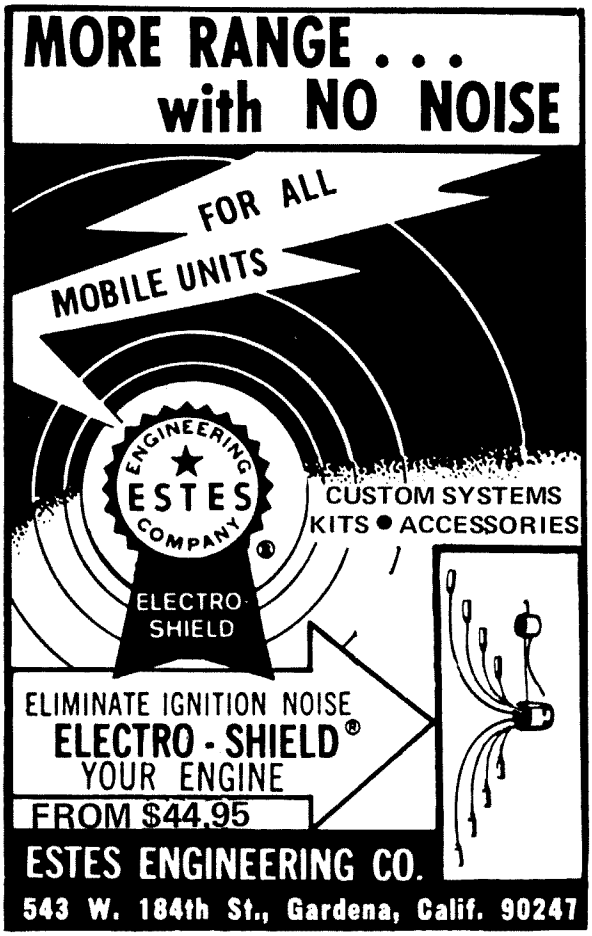
Confessions of n Surplus Hound

Some hams are builders and prefer to experiment, some do otherwise. This article is dedicated to the first group. Before the war, I got started in the ham game . . . scrounged and swapped for parts and made do with whatever was available. Slightly used Weston meters at $3 each, secondhand midget tuning condensers at 50¢ . . . that sort of stuff.

Came the war and the subsequent flood of surplus equipment, some good and some not so good, but all of it very cheap. Incredible bargains! An awful lot of that stuff found its way into my basement. I had accumulated so much junk that prior to moving to the new location several years ago, I started six months early to swap, sell and give away all the gear that couldn't be carted to the new QTH. Resolved never to let it happen again! But it did. Maybe that's because I'm hooked on surplus . . . at any rate, here are a few useful tips.

As I said, there is some very good stuff on the surplus market and some not so good. If you should buy a damaged night-light control and fool around and fix the thing, that's all right. Even though you may never use it, you've learned something. But never buy a piece of gear just because it looks nice. Otherwise you will end up with a shack full of surplus and no room in which to put your operating equipment. Don't laugh, please. This has happened to stronger men than you!

Where to purchase the surplus? When Cortlandt Street – New York's oldtime "Radio Row" – was in existence, it was quite simple for thousands of bargain-minded hams to snoop and shop, to visually inspect the gear that was for sale. Today Radio Row is but a fond memory but this illustration points up rule number one: See before you by. This might be impossible in certain cases, so we go on to rule number two: If your buddy bought an item from a particular surplus merchant and was happy with the deal, the chances are good that you can buy the same or similar gear from the same outlet with satisfaction. I can now hear you asking "What happens if I can't apply rule number one or rule number two?"



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You could take pot luck and perhaps end up unhappy. But there are a few angles whereby you can tip the odds in your favor. No guarantee of success, mind you, but a big improvement in your chances. Take a close look at any surplus hound's catalog file. Along with all the popular mail order catalogs you will find catalogs from some of the larger surplus houses. This is usually a good sign, for it shows that this particular firm thinks enough of its customers to go to the time and trouble to assemble, print and distribute a catalog. What with annual or more frequent updating, this all takes time, money and effort. These firms put out these catalogs because they want you to be a satisfied customer. Also, when you receive a catalog, many of the items are illustrated. This works in your favor, since you will have a fairly good idea of what the gear looks like before you buy it. In a catalog there is room for a description, plus specs such as size, weight, color and so on. Less chance for misunderstanding.

Other merchants operate along slightly different lines. That is, they do not feel justified in making up and issuing a catalog at regular intervals. This is particularly true in some cases where the firm specializes in big-ticket items, fewer in number, such as HF receivers, used oscilloscopes and relatively expensive test equipment. The majority of firms that advertise are ethical, and in case you are disappointed, a letter to the firm in question will usually rectify the situation. The chances of your getting burned are greatly reduced if you will follow these simple rules. Why shouldn't you profit from someone else's mistakes?

I have been well served by many of 73's advertisers, among them Meshna, Fair Radio, Jefftronics and Columbia to mention just a few. In the old days I was forced to buy surplus in order to save money. Now I find that I buy the stuff to save time and trouble, not to mention exasperation, since the nearby radio stores don't always carry the particular parts needed. What's that saying by the French to the effect that "The more things change, the more they become the same?"

W2OLU

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Amateur Radio

APRIL MCMLXXII Monthly Ha

HAMS AID IN SEARCH

On Saturday, January 22, 1972, St. Louis area amateur radio operators were called to assist in the search for a young man missing from his residence at the St. Louis State School and Hospital. The young man was retarded and partially blind.

Initial efforts to locate the youth were spearheaded by volunteers from the local Youth Association for Retarded Citizens (YARC). After 24 hours of search, YARC leader Tyrone McNary contacted county police seeking walkie-talkie radios. Sargent Joe Owings, Police Radio Supervisor and ham operator, was on duty at the time and immediately contacted members of the St. Louis Repeater Club to request their cooperation. One of the primary functions of the club is to provide emergency communications using VHF equipment owned and maintained by the members.

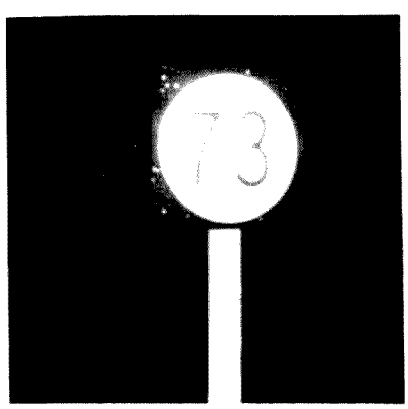
Lionel Doak KØDCQ and Clarence Herron, Jr., WØKUJ instituted call-up procedures, and within thirty minutes a dozen hams equipped with mobile radios and portable units headed for the search area. Bob Netherton WAØQAH established a radio command post to coordinate the YARC search groups. Other hams with portable transceivers were assigned to specific search parties. The command post was transferred to Sgt. Owings' radio-equipped camper van when he arrived after duty hours. Darkness forced the search to be called off for the night.

Sunday morning additional hams, YARC members, Scouts, and other volunteers gathered at the radio command post to continue the search. Each group of eight to ten walkers included a radio operator. Mobile operators visited area churches and homes to inform the public, with a description of the youth. Many of the YARC volunteers had been working with little rest since Friday afternoon.

Unfortunately the story did not have a happy ending. The body of the youth was found in a creek bed only about ¼ mile from the school grounds. However, the dedication displayed by the young adult YARC group was an inspiration to all. Their volunteer work with retarded citizens usually goes unnoticed. Their involvement and compassion was evident throughout the search and especially when the sad end was known.

In the future, it is recommended that authorities faced with an emergency contact radio amateur volunteer communication specialists just as soon as the requirement for assistance is known. The search was into the second day before the St. Louis Repeater Club members were contacted.

Radio operators who participated include Joe Owings KØAHD, Lionel Doak KØDCQ, Clarence Heeron, Jr., WØKUJ, Robert Netherton WAØQAH, Robert Wingerter KØABA, Robert Familton WAØQOL, William Armstrong WØNC, Randy Wachter WBØCPG, Marianne Familton WAØQOM Forrest Murphy WØFEM, Vernon Hayes WØCYF, Neil Widener WA9OTB, Ralph Edmonds WØKUY, John Landsberger KØLUX, Dennis Hutchins WA9RDY, Bill Reichert WA9HHH, Royce Brown WA9UUF, John Carrel WAØITI, Joe Rome KØPJB, and Robert Silvey WB9CDF.



Arnold Krauel WAØGUD, was there when 73 stretched out its wings and claimed the land 11 miles east of Audubon, Iowa. As you walk down the State Road 73's of life, watch out for the next place 73 strikes. Keep your camera ready.

ECARS PREXY

Hal Winston W2DIR on January 15th assumed the position of President of ECARS, the East Coast Amateur Radio Service. 73 Magazine extends its hearty congratulations to Hal and wishes him the best of luck in this position.

JOHN K3BNS NEW CHIEF OF RULES & LEGAL BRANCH, FCC

Reprinted from the X-Mitter, Penn. Wireless Assoc.

John B. Johnston K3BNS, has been appointed Chief, Rules and Legal Branch, Amateur and Citizens Band Division, of the Federal Communications Commission, effective 14 February 1972.

John will be working under Prose Walker W4BW, the head of the amateur and citizens branch of FCC. He replaces Bill Grenfell W4GF, who retired early in 1971.

John was first licensed as KN2HHR, becoming K2HHR and later K8DAI before moving to Levittown as K3BNS. He is a past president of Penn Wireless Association, past president of Frankford Radio Club, and has received numerous awards for his amateur radio activities. He has received the ARRL CD Article award, and has had many articles published in QST, X-MITTER, CQ, and 73. He is a Life Member, ARRL, and ex-Assistant Director. John is active on all HF bands on CW, RTTY, and phone. He places high in Sweepstakes and the DX contests.

News Pages

SYMPOSIUM DISCUSSES FCC RULES

Representatives of New England and Eastern New York repeater groups discussed FCC regulations which they thought would be beneficial for the orderly growth of two meter FM.

The first item to be brought up was the matter of the frequency of control systems. Under the present regulations all control systems must be on 220 MHz or above. This rule has been around since some time in the 30's or 40's and has been a great big pain with little redeeming merit. Suggestions were made that all restrictions be removed regarding control frequencies and that the end result be defined instead of the means of achieving it. The result is effective control of repeaters in this case.

It was proposed that control be permitted from mobile points. Considerable discussion brought out that there seemed to be no reasonable argument against permitting mobile control of repeaters. The negative thinkers came up with a wide array of improbable difficulties which might demand fixed control points. The positive thinkers countered each negative thrust and won the vote of the majority.

The same discussion got started on the subject of monitoring and whether mobile monitoring should be permitted. The heretical question was raised as to whether monitoring was in all cases absolutely essential and the majority was again persuaded that under certain conditions such as coded access to the repeater no monitoring should be required. Completely open repeaters should be monitored.

The group agreed that unattended repeater operation be proposed to the FCC.

The matter of control of a repeater brought forth a good deal of opinion and some heat, finally being resolved after much compromise with the recommendation that primary control of repeaters be on 220 MHz or above or by means of telephone wires or some other such hard wire control. Primary control was defined as the ability to turn the system on and off. Secondary control or emergency control was defined as the ability to shut the system off or change its functions.

The group also voted to support the petition that has been under consideration by the FCC for some years now for extending Technician operation to the entire 144–148 MHz band.

The group voted a preference for 40 kHz spacing between channels on the 220 MHz band instead of the rumored RACES desired standard of 30 kHz. The wider spacing would be in keeping with equipment expected to be available soon to amateurs and would permit the eventual splitting of channels down to 20 kHz without undue adjacent channel interference. The 30 kHz standard now in use on 146 MHz has caused great grief when split further to 15 kHz and this disaster might avoid repetition if RACES would go along with the repeater groups and agree to 40 kHz spacing. Equipment can be made for 15 kHz spacing, but it would be expensive . . . very expensive.

DYCOMM DEMAND

A letter from attorneys representing Dynamic Communications demands that 73 publish a retraction as follows:

> The models advertised on page 106 of the February edition were incorrect, that they were both discontinued as of January 5th, 1972, and that new models and new prices were in effect from that day forward.

We do try hard to see that only ads that are wanted are run. In the case of Dycomm a proof of the ad was sent with the following statement: "Here is a rough proof of your ad for the February issue of 73. There will be time for us to send further proofs and get your okay on any changes or corrections if we receive your material by December 10th. We cannot guarantee proofs subject to corrections on material received between December 10th and 20th. Contract advertisers do not require an insertion order. As per contract agreement, below shown proof will appear in the February issue. Absolute ad deadline for negatives, changes and corrections is December 20th."

Though this proof was sent to Dycomm on December 5th, no word of any kind was received from them before the issue went to press. The next letter received was from their attorneys demanding a retraction. Had 73 received any communication whatever from Dycomm, by phone, letter, telegram, etc., the ad would have been cancelled. No word was in fact received.

NEWS FLASH

Reprinted from the February *Ham Rag*

As we go to press, Ham Rag's nosy reporters have smelled out a scandal at ARRL Headquarters. Seems that ARRL President Robt. W. Denniston WØDX, has been out beating the bushes in opposition to ARRL's proposal for phone band expansion, so the League has fired WØDX and replaced him with Harry J. Dannals W2TUK, Director from the Hudson Division, as Prexy.

CLUB 18 YEARS OLD

RSBG RadCom – The Radio Amateur Invalid and Bedfast Club, now has close to 400 members in 13 countries and will celebrate its 18th anniversary next year. It extends a welcome to licensed amateurs and SWL's anywhere who are handicapped in any way. Membership is free and the club's newsletter, *RADIAL*, is sent monthly for a small sum to help cover printing and mailing costs.

Inquiries should be addressed to the honorary secretary, Mrs. Frances Woolley G3LWY, Woodclose, Penselwood, Wincanton, Somerset, England.

ACTION AUCTION

With a title like the "Action Auction," the Montgomery ARC must be planning a big turnout. The auction will be held at the Civic Center in Gaithersburg on Sunday, May 14. Bring your gear from 10 to 12, and the auction will begin at noon. Talk-in on 94.

HAVASU HIGH SCHOOL HAMS



Left to right: Randy Strange; Gary Keller; Tom Clark; Howie DiBlasi, Instructor, of WA7RTM, the Lake Havasu High School Amateur Radio Club. The club recently handled 200 messages for students and faculty to all parts of the world. Traffic was passed to 25 states and many foreign countries.

ADDITIONS TO TECHNICAL AID GROUP

(see March '72 *73*)

Joseph Botwinick WA2UVD 137–45 231 St., Laurelton NY 11413. Project coordinator. Joe can lend a hand with AM, antennas, Novice problems, converters, test equipment, surplus and other general help.

Jim Venable K4YZE, 119 Jancey Dr., Marietta GA 30060. Jim is well qualified to lend assistance in VHF-UHF design of transmitters and receivers and antennas as well as being adept with test equipment and solid state matters.

QSL MANAGER OF THE MONTH

Scott's QSL service and DX Assn. is proud to announce the recipients of the QSL Manager of the Month golden microphone trophy. Each month since September 1970 one of the following managers was awarded the trophy for outstanding service. ZL2AFZ, VE3EUU, W7VRO, WA3HUP, W3HNK, KH6GLU, 1NDXA (K3RLY), W3CTN, WA6AHF (xyl Fern), WA2DWE, WØQGI (WAØ buro), W5QMJ (W5 buro), WB8ABN, W2MZV (Browning DXped mgr), W2GHK (DOTM), WA6MWG, KØZFL (K, WB, WN Ø buro), K4ZCP.

By Philadelphia Hams

TV NET FORMED ON 439 MEGAHERTZ

Paul Rilling WA3HIT

A new net was started on Friday, January 28, 1972 by net control K3ZKO Ron Cohen of Philadelphia. What makes this net unique is that it is a TV net (fast scan). Sponsored by the Mt. Airy VHF Radio Club, Inc. (Pack Rats), the net meets each Friday from 7 to 10 P.M., Philadelphia time. Ron (who is known as "Captain Video") believes that this is the first TV net to be formed in the East, and the first of its kind anywhere in the U.S. The frequency is 439.25 (video *and* audio). Philadelphia hams call this frequency "Channel 13¾." If you cannot copy K3ZKO-TV, look for WA3AXV-TV, whose handle is also Ron. K3ZKO will run test with those stations who wish, as well as listening on 146.58 MHz (2 meter FM ATV engineering channel) for those who can only receive but want to take part. Both Ron K3ZKO and Paul WA3HIT have color receivers for those who want to run tests while transmitting in color. Anyone can receive this net on a conventional TV set with a modified UHF converter (frequency adjusted 30 MHz at low end). Ron K3ZKO expects about twenty ATV stations from New Brunswick, N.J. to Westville, N.J. to be regular check-ins each week, and many more stations on 146.58 FM, who are monitoring only.

NJ AMATEUR OF THE YEAR

On January 21st, Anthony Butterhof K2JOX, was presented with a plaque and cash award in recognition of his many years of service to the southern New Jersey area hams. His dedication to ham radio has been demonstrated many times over the years.

He has served as president and member of the Board of Directors of the Southern Counties Amateur Radio Association, has served onany committees, participated in many SCARA activities and programs. In 1971 he organized several transmitter hunts, promoted club activities, was prime mover during Field Day, technical advisor in the installation and operation of the club repeater, and served as chairman of a special committee that established WX2MAP, the special events station that operated in conjunction with the Miss America Pageant. Anthony acted as coordinator between the Pageant officials and the amateur club. He provided for acquisition of material and installation of the antenna and radio equipment for this station, participated in the operation of this station, and coordinated the QSL card efforts for the event.

Currently he is the committee chairman of the Kiwanis International special events amateur radio station, due to become operational this year. He has organized code and theory classes for prospective Novices at the local high school. And he has held many positions in local and county Civil Defense organizations.

The award is presented each year by Atlantic City radio station WFPG to the outstanding amateur in the southern New Jersey section.

NEWS FROM AROUND THE WORLD

According to a newsletter of the Canadian Amateur Radio Federation, the age limit for the Amateur Experimental Service has been dropped, the eleven meter band is to be turned over to the exclusive use of the General Radio Service, and the Ministry of Communication is considering the lowering of qualifications necessary for amateur radio operators and creation of a new class of junior license restricted to operation in a UHF band and an output of three watts. This last item is particularly interesting as the CARF feeling is that any matter about amateur radio should have the approval of all licensed amateurs. Until all facts are known, however, concerned persons should not condemn the Ministry. There is the possibility that this Restricted Amateur license will promote the development of 450 MHz equipment. This will be a worthwhile event to follow.

METRO SNO-DO 100

By Al Molden VE3CLE

Reprinted from the Toronto FM Society Bulletin

After a delay of one week, Metro's first recorded snowmobilathon took place February 5.

Presented by several Metro area Civitan clubs, the Sno-Do took place over a hundred-mile course. Similar to a walkathon, but run on snowmobiles, it offered snowmobile owners a fund raising, fun-type endurance test for their machines. It was not a contest, but each entrant was asked to obtain sponsors who paid for each mile completed. All monies were equally divided between the participating clubs, whose common objective is to fight mental illness and help mentally retarded citizens.

Point-to-point communications on the rally was organized and carried out by the Toronto FM Society. They filled in the snowmobile/mobile end where a lack of ham manpower was evident. Four FM mobiles, those of Stan VE3AZD, Dan VE3CIQ, Barry VE3FBH, and Ray VE3GSK, were positioned at strategic points along the course, and track was kept of the position of each snowmobile as the day progressed. The base station was supplied by Chuck VE3KQ and ably manned by Al VE3CLE.

It was a good day for hams and snowmobilers alike. Without ham help, the event could not have been as successful as it was - other clubs are encouraged to lend support whenever and wherever reliable communications are needed.

HOT GEAR

On Feb. 3, 1972, YAESU Model FT-101 Transceiver, S/N 107036, equipped with CW filter, was stolen from the automobile of WA2YSW while it was parked in the driveway of his home. Contact Frank W. Widmann, 328 Farwood Road, Haddonfield, N.J. 08033, or Officer Latham, Police Headquarters, Borough of Haddonfield, 242 Kings Highway East, Haddonfield, N.J. 08033.

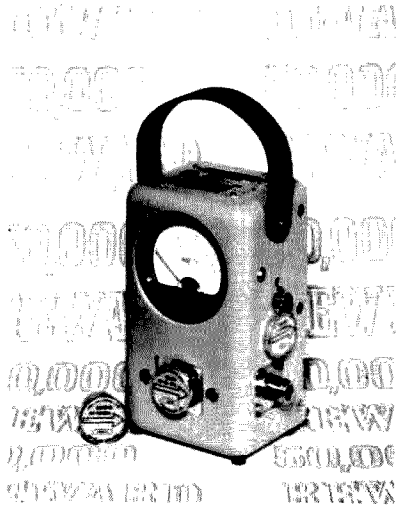
A 2 meter FM Standard Transmitter SRC 806M, Serial Number 102703, was stolen from the car of Clem Mathias W6NPV on January 25, 1972. Contact him at 3134 Coronado Ave., Imperial Beach CA 92032.

In Elmira, N.Y., Glen WB2LRR reports a Drake ML2, Model No. 20189 100N PL, stolen.

List from Past Issues:

Mfr., Model, Ser. No.	Owner	Issue
Halli, SR46A, No.446100	WA1EMU	9/71
Reg., HR-2, No.04-03505	WA5BNM	11/71
Sonar, FM3601, No.1003	WB2ARM	11/71
Coll., 75A4, No.804	WØMGI	12/71
GE, Portable, No.1041218	K2AOQ	1/72
Coll., 75SE-B, No.15640	Col.St.U.	1/72
Coll, 21S3, No.12000	Col.St.U.	1/72
Coll., 516F1,No.1649	Col.St.U.	1/72
Simp. Mod-A, No.35457	W2PWG	1/72
SBE SB-33 No.103906	WA5JGU	2/72
Heath HW22A No.907-1835	W1BDX	2/72
Nat'l HR050 No.280019	WA5DQF	2/72
Halli., SR160 No.416000-108039	K9YVA	2/72
Drake TR3 No.3858	WA9EYL	2/72
Coll., KWM2A No 13815	ARRL HQ M. Godwin	2/72
Coll., 312B4 No.59920		
Coll., 30L! No. 40084		
Coll. MPL No. 44507		
Coll. MM1 (mob. mike)		
Misco minispkr.	Sgt. Hopkins Wilm. DE Police	2/72
Swan SW174 No. 416-5	WØAXT	2/72
Reg. HR2A No.04-05896	K4GBL	2/72
HR2A, No.04-6208	W5FXX/5	3/72
Heath SB102,No.132-128107	W.Singer Woodbridge VA 703,491-2257	3/72

BIRD OFFERS REWARD



Bird Electronic Corporation offers a reward to twenty owners or users of a model 43 THRULINE RF Directional Wattmeter. Designed under the direction of the late microwave pioneer J. R. Bird when the industry was in its infancy, production of the famous "43" has just passed the 50,000 mark. This portable insertion wattmeter measures from 1 to 10,000 watts from 0.45 to 2300 MHz in discrete bands determined by the plug-in element used.

In celebration of the 50,000th unit, Bird will give away 20 standard plug-in elements to serial numbers taken at random on 10/10/72. Users selected will choose their element according to desired frequency range and full-scale power level. Mail the serial number of your model 43 on a card to *Bird Electronic Corporation, 30303 Aurora Road, Cleveland (Solon), Ohio 44139.*

THE 50 MHz BAND

by WAØABI

The December openings started off with a bang early in the month, giving rise to hopes of another period similar to 1967 but after openings the morning and evening of the third and the evening of the fourth things calmed down. While there were multiple openings, they were of short duration and rather spotty. WA2ENZ and WB2BLL joined in a ragchew with KØRIR, WØRVF and WAØABI on the 20th while on the following day VE1's were heard but were too far down in the noise to work.

Word has it that the 1972 meeting of the Midwest VHF Society will be held in Kansas City, but no date has been set as of this writing. Hopefully a date will be announced shortly so those who must schedule their vacations well in advance will be able to make the necessary arrangements. Several people from this area were forced to miss the 1971 meeting in Sioux Falls due to inability to arrange time off from work. A Kansas City trip is in the planning stage; hope to see you there.

There is good news for those in need of a Kentucky confirmation.Ted WB4VLH, is newly active from Paducah with a Clegg Venus and a pair of 4X150's. Ted joins Dave WB4YIH, who has been on for some time from Owensboro as K9DZK/4. These are the only Kentucky stations ever heard from this midwest location. W5SXJ was heard aeronautical mobile on both legs of a business trip through the St. Louis area. Ray seemed to be having a ball making contacts at the drop of a hat and at times rag chewing over a four state area.

Mike WØZYS, is QRX while the tower is being moved to a new QTH and should be back on the air shortly.

Several Heath SB-110's around have developed a habit of jumping from 1 to 1½ kHz, in each the problem started abruptly and after the rig was several years old. In each case the problem was found to be in the heterodyne oscillator circuit. Should you have this problem, blow about $2 and replace all the resistors and capacitors in these circuits at one time. This may seem wasteful and you may never know which component was defective but it is far better than removing the shielding and bandswitch to replace components one at a time.

Your assistance in supplying current, factual reports of activity are needed to keep the column interesting and useful. I would also like to receive your comments as to what you would like to see in this space. Unless you speak up, you'll have to put up with my findings.

HAM TUNES IN TO BURROWING BURGLARS

by Henry Maule
Reprinted from the Knoxville (TN) Journal

Robert Rowlands is a prosperous 33-year-old company director who maintains an elegant apartment in London's West End. Like many a hard-working businessman, Rowlands relieves the pressure with a hobby. He's a radio ham.

At 11 o'clock one seemingly quiet Saturday evening not long ago, Rowlands turned on his high-powered equipment and began reaching into the ether for another ham, preferably someone far off. Perhaps he might even wind up chatting with none other than Jordan's King Hussein, who escapes from the woes of the troubled Middle East by doing a little radio hamming himself.

As luck would have it, Rowlands' short-wave receiver was tuned in on 27.5 megacycles. This was precisely the frequency of a set of walkie-talkie radios being employed, at that very moment, by an enterprising gang of bank robbers who had tunneled their way into Lloyds Bank branch on nearby Baker Street.

The bank is situated only a block from 221B Baker Street, the address of Arthur Conan Doyle's famous fictional detective, Sherlock Holmes. Ironically, although their equipment was ultra modern, the thieves were employing the same technique of the robbers in Doyle's story, "The Red-Headed League."

The non-fiction gang tunneled 15 feet downward from a vacant store two doors from the bank. Then, with picks and shovels, they dug their way 40 feet horizontally under a restaurant called "Chicken Inn" to the bank itself. Next, they dragged in gas cylinders and a thermic lance to attack the four-feet-thick reinforced concrete floor of the strongroom. A thermic lance is a specialized cutter used industrially to cut through concrete.

The diggers had walkie-talkies and so did a lookout planted, with binoculars, on a nearby luxury house rooftop. It was on a little tete-a-tete between the gent on the roof and the burrowers that Rowlands beamed in with his sensitive receiver. It was the night of this past Sept. 11.

It took a little time for Rowlands to catch on. The first thing he heard was the exultant cry, in a decidedly Cockney accent: "We've got at least 200 grand!" The robbers had reached the vault.

Like a dutiful citizen, he telephoned the nearby police station in Marylebone Lane. His immediate impression of the reaction at the other end was that they believed him to be a hoaxer or a crank, but he eventually persuaded them to send an officer around to his home to hear for himself.

Rowlands urged that a General Post Office detector van should be called in at once to pinpoint the source of the robbers' conversations. The constable assured him this would be done immediately.

The gang's crosstalk made reference to drilling in the street, and there was also talk of a waiter in a nearby restaurant who kept peering through a window.

Rowlands felt these were two valuable clues which would help the police pinpoint the actual bank in which the raiders were so diligently at work. But the police did not seem to appreciate the importance of conversations the radio ham was taping.

Furious at their lack of concern, Rowlands phoned Scotland Yard, told them what he had heard over the radio, and said it was quite clear a robbery was in progress involving a lot of money and valuables.

Even though the Yard's reaction did indicate more interest than had been shown at Rowlands' local police station, their approach to the bank robbery was pedestrian in the extreme.

Two days later, on a Monday, the completed robbery was discovered at the Baker Street Branch of Lloyds Bank. In the angry official inquiry that followed, the big question was: What about the Post Office detector van that Rowlands had suggested?

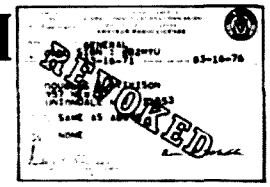
The Post Office people insisted that the robbers stopped transmitting five minutes after the detecting equipment was brought into play.

"If we had been alerted sooner," said a spokesman, "we could have found the transmitter very quickly. Once in the area, we could have pinpointed the building in a matter of minutes."

The police reported that they had put in a call for the use of the detector van 10 hours earlier, but had been told it was not possible to contact the unit because it was not on 24 hour duty. To which the Post Office replied that the police had not indicated there was any particular urgency. It did nothing to reasssure the owners of the robbed deposit boxes when Scotland Yard later issued a statement that they and the Post Office were tightening their emergency links. "We have established where the weaknesses were," said a spokesman. "We have learned lessons from this episode and it won't happen again."

As a certain onetime resident of Baker Street would undoubtedly have commented, were he around: "What can one expect? It's elementary, my dear Watson."

WITH THE FCC



Following is a reprint of an article in the Texas VHF-FM Society NEWS in which a summary of Prose Walker's comments at SAROC appeared. In the relaxed atmosphere of his visit, he was able to comment more explicitly on several issues of prime interest to hams. This article represents a superb review of current FCC thinking. It must be remembered that Mr. Walker stated his ideas in places, and that unless indicated, these items have not been placed into effect.

FCC AMATEUR CHIEF VISITS NORTH TEXAS

A. Prose Walker, W4BW, Chief of the Amateur and Citizen's Division of the FCC was a guest and featured speaker at the January 10th meeting of the Richardson Wireless Klub. Throughout his visit, Mr. Walker was constantly bombarded with questions about the probable outcome of the various rulemaking actions pending before the FCC. Mr. Walker was free and open with his answers, and lent considerable assurance that we are, indeed, represented by a ham's ham. He did preface his remarks with a caution that they be interpreted correctly and kept in context. That context is worth explanation.

As Chief of the Amateur and Citizen's Division, Mr. Walker directs and administers the preparation of the report and order which is the culmination of any rulemaking procedure. However (and this must be understood clearly), the initial report and order prepared by his division is not necessarily ever issued as it was written. After his division's work, the document must be analyzed by the FCC legal staff, by the Safety and Special Services Bureau, and finally by

the seven commissioners. There are many opportunities for reversals in this approval path, and the final report and order may be substantially different when issued than when drafted. Mr. Walker's beliefs and findings, then, can be assumed to have a direct influence on the work done in his division, but cannot be assumed to carry promise about the final rules.

Mr. Walker thinks the report and order following docket 18803 (VHF Repeaters) might be issued before mid-year. It will probably be issued first, before the phone band expansion, "eye bank," and 220 MHz hobby band subjects are finished. In summary, it seems that VHF repeaters will be dealt with kindly and almost completely in accordance with our Society's comments. The extensive linking of repeaters for non-emergency use might not be permitted beyond a total of two, or at the most, three machines.

Mr. Walker believes that sub-band allocations as proposed by the FCC are not necessary beyond prescribing what portion of each band may be used for repeaters. He delivered an admonition that we hams coordinate immediately, effectively, and nationally to formulate a frequency coordination plan to obviate interference between repeaters and stations of other types, and among repeaters themselves. Such coordination would have to take into account the newly established amateur satellite service and other users of the spectrum. While not suggested by Mr. Walker, this subject seems to be of sufficient importance that it might well become a crusade within the ARRL.

The information required on license applications for repeaters may change to include those items directly related to establishing a service radius. Such items as height above average terrain, power output of the transmitter, transmission line loss, and horizontal and vertical pattern data may well be required on future applications. Conversely, the requirement to explain in detail the functioning of every relay and other system component probably will be eliminated.

Access by tone may be required, if for no other reason than to establish without doubt the using operator's intent to key a repeater. This possible requirement ties directly to the subject of unattended operation. The commission has apparently, regardless of Mr. Walker's disposition on the subject, not yet reached a decision about whether the prime responsibility for repeater operation lies with the trustee of the repeater or the licensee of the station using the repeater. Carrier-operated repeaters appear to be likely to be prohibited unless they are monitored and controlled full time. Tone-access repeaters, however, seem to be better candidates for unattended operation – although the subject is by no means resolved at this time.

Logging of transmissions will probably go, automatic identification of repeaters will stay (and in fact, a future requirement is being studied for fully automatic digital identification of all transmitters), in-band control probably will be allowed, and a technical log might be required. Rather than list each of the points made by each of the comments submitted to the commission, Mr. Walker indicated that we probably would be permitted each of the boons we sought – with the possible exception of unattended operation. He personally believes as we do that unattended operation should be allowed and readily cites the precedent established by the land mobile services in support of his beliefs. His ability to convince the commission, however, will be the determining influence in the outcome. Considering Mr. Walker's knowledge, experience, level of concern, and understanding of what ham radio is all about, coupled with his apparent deep interest in repeaters, it is difficult to be anything but optimistic at this point.

Mr. Walker touched on several other subjects outside the area of VHF repeaters. Some of the more significant items are reported here. There probably will be an expansion of the 75 and 40 meter phone bands. More space might be provided on 160 meters. Ten meters might support a small allocation for repeaters. The EIA petition for reallocation of part of the 220 MHz band for citizen's band operation hasn't been resolved. There is much pressure for its adoption, but there are serious potential problems in the areas of enforcement and the federal government's priority in the band for radio location services. Because the issue is so "up in the air" at the moment, Mr. Walker suggested that amateurs do nothing until or unless the FCC issues a notice of proposed rulemaking.

The commission is concerned about amateurs who run more than the legal kilowatt. It seemed that the FCC has just about run out of patience with the problem and is prepared to legislate a cure. One solution might limit the plate dissipation rating of vacuum tubes to a certain level. The best solution is to clean up our own ranks of the violators and scofflaws. The message was very clear. Another subject discussed in the same unpleasant vein was the apparent large number of frauds holding conditional and technician licenses. In six months of 1971, 134 licensees of various classes were called in for re-examination. 59% failed to show, 17% failed the test, 24% passed. Suspected perjury concerning qualifications prior to renewal time has attracted the commission's attention, and steps are being taken to reduce the number of violations.

The entire subject of call signs will shortly receive commission attention. The block of prefixes AA through AL have been assigned to the U.S. but have not been assigned in the amateur service as yet. Many possibilities exist, and the final outcome may be a long way off, but some examples of what might be done are: Extra class licensees might receive prefixes W/K/WA/WB, etc., with a one or two letter suffix. Advanced class might use part of the AA-AL block. Generals might get nothing but "1 X 3" calls. Novices "2 X 3" with WN or KN prefixes, and repeaters the same with WR or KR prefixes. The idea supports two considerations: the most obvious is the benefit to the monitoring service in determining the class of licensee; and a secondary benefit is the incentive attached to receiving a prestige call in the higher class license grades.

Two new grades of technician class licenses may be established in the future to replace the current technician class. They would be no-code licenses, but with two grades of technical competence indicated by names like "VHF general," or "VHF extra," just to cite an example. Repeater trustees would likely be of the higher grade only. Mr. Walker's discussion on this subject received enthusiastic support from his audience.

Mr. Walker's final point concerned the possibility of establishing more HF ham bands. Many countries are ceasing operation of their HF fixed stations in favor of cables and satellites which provide much higher reliability. The spectrum vacated by these services could be made available, in Mr. Walker's opinion, if we hams begin to work now at a professional and diplomatic level. The next World Administrative Radio Conference in 1977 will treat HF spectrum allocations, and it behooves us, he thinks, to get busy right away within the League making preparations. It is a serious and difficult subject which encompasses not only domestic but international effort of the highest professional quality, but it is not impossible. Mr. Walker tantalized the audience with visions of ham bands every 2 or 3 MHz throughout the entire HF spectrum!

PLEASE INCLUDE YOUR ZIP CODE WHEN YOU WRITE 73.

FCC REPORT

by Bill Grenfell W4GF

Reprinted from January 1971 Auto-Call. Re-reprinted from February, 1972 Ra Ra Rag.

The ARRL response to the Commission's Docket 19245 Notice of Inquiry has been filed and is, I think, quite revealing of an attitude which, unfortunately, does little to help the FCC resolve the problem.

Briefly, this concerns Section 97.39 of the rules which say amateur station licenses "will not be issued to a school, company, corporation, or other (non-amateur) organization, nor for its use . . . " Although it has been advising others of its belief that the rule prohibited amateurs from furnishing communications on behalf of non-amateur organizations for more than 14 years, the FCC's reply to a Lion's Club letter that the rule applied to the Eye Bank Net (which is sponsored by the Lions' organization) caused a big fuss and resulted in the writing of some rather heated and misleading editorials. See November 1971 QST, page 79 for the filing, my June 1971 Auto-Call report (page 5) and October 1970 QST editorial (page 9).

While Bob Booth's work in preparing the comments for ARRL is quite comprehensive and well documented, I believe it strays from the most productive direction and that some of the arguments presented weaken, rather than strengthen, the League's presentation. For example, the comment traces the controversial "nor for its use" phrase back to the amendment of the rule made by the FCC in 1938 as a result of the League's request "to close the loophole." It states that "the League most certainly would not have suggested the addition of the phrase "nor for their use" and "nor for its use" if there had been even the slightest indication that the phrase might even remotely be interpreted to restrict the message handling activities upon which the League has been built since 1914." League Secretary Warner's December 1928 QST editorial discussing the "nor for its use" phrase is cited. What the League's comment fails to recognize and deal with is that *the phrase has been interpreted to apply to communications* and therefore, if this is undesirable, the *only* way to prevent such an interpretation in the future is to change the rule. It should be recognized that early rule language and interpretations cannot remain unchanged when the communications and the people involved in station operation and in the regulatory process change as time marches on!

From my point of view as a former FCC employee of 20 years involved in this amateur regulatory process, I think I can reflect the Commission staff's point of view in observing that the reference to the Commission's "persisting in its misinterpretation of Section 97.39" is hardly going to win them over. I think the views of a majority of the Commissioners themselves is probably well represented by Chairman Burch's statement to the Washington Chapter of the QCWA last March. I recommend that you read it. (QST, May 1971, page 81)

The Commission and staff has given the amateurs and their League every opportunity to participate in arriving at an agreeable solution. I hope the League will see its way to forget the past and provide positive help to the Commission.

Gf

FROM THE FILES OF THE FCC

Finds 'em, Catches 'em, Cancels 'em!

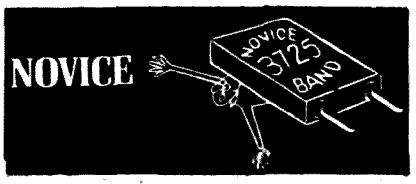
A U.S. District Court Jury found two Des Moines men guilty of violating FCC Rules governing the use of CB radios. Raymond W. Huxford, 55, was convicted of exceeding FCC limits on CB radio antenna height, power output, length of broadcast and of violating FCC Rules by operating on unauthorized frequencies, using an unauthorized call sign, relaying messages for persons other than himself or family, and sending messages as a hobby or diversion. Mr. Huxford was found guilty on six counts of violations of the Communications Act.

James O. Edmunds, 40, was convicted of exceeding FCC limits of length of broadcast, operating on unauthorized frequencies, using an unauthorized call sign and sending messages as a hobby or diversion. Mr. Edmunds was found guilty on four counts of violation of the Communications Act.

U.S. District Court Judge William Stuart continued bond at $2500 on each defendant and delayed sentencing pending pre-sentence investigation.

Refer to 73, December 1971, for more details.

The General Class license of W9LMR is under suspension for out of band operation. He was monitored while operating on 7004.6 kHz and was so notified of the violation. FCC rules require written replies to such notices. LMR did not reply to the first nor subsequent letters and hence the suspension. In other action, the Extra Class license of WB4DXX is under suspension for the remainder of its term for several violations. The first was communicating without identifying his station at proper intervals, and for transmitting signals for a purpose other than communication. Official notices of violation were sent on two occasions for these and no reply was made. On another date, the transmitter of the licensee was transmitting in "excess of its modulation capabilities for proper technical operation, resulting in excessive distortion and frequency instability." A notice was sent to WB4DXX and he replied explaining the circumstances. A third violation was committed on another date when he willfully interfered with other signals. The response to this notice claimed the interference was willful but not malicious, and the interference was due to negligence on his own part. In the FCC order, the findings are summarized in the statement, "That the licensee's actions described above are contrary to the public interest, convenience and necessity standard of Sections 301 and 307(a) of the Communications Act of 1934 . . . " It was ordered that the Extra Class license of WB4DXX be suspended for the remainder of the license term.



There is such a variety of equipment available kit form and ready made *and* homebrew too that setting it up for total enjoyment should be emphasized. Your station has to be efficient and comfortable too. Some Novices (and higher class licenses) prefer to install their stations in cabinets or platforms that are above the operating desks. This looks well and it leaves the table top clear for logbooks, pencils, keys, and mikes. All the additional space under the rig can be used for storage and also for extra room if your operating desk is also used for a work bench. This presents a neat and orderly appearance that is impressive to visitors and also convenient to operate if controls do not have to be adjusted often.

Another arrangement is to tilt the front of your equipment so that it seems to face you as you look down at it. This eliminates the squinting and hunching down to read dials and meters. What's more, it looks like the gear is mounted on a professional work bench. Perhaps a short SWR bridge can be placed underneath to act as a support. This adds a nice touch as this otherwise empty space is filled with another knob or two and a meter.

(continued)

But is your desk set up for maximum operating convenience? Can you sit at the table comfortably for several hours and not get tired from eye strain, arm muscle fatigue, writer's cramp, or other afflictions of the ham? The first arrangement described above looks fine and as mentioned, as long as you do not frequently retune the transmitter or receiver, it is easy to use. Certainly there is adequate space to stretch your entire forearm on the table to make sending with a hand key easier, and there is sufficient room to work with scratch pad and log books. But can you sit there for a few hours staring straight ahead at eye level, staring at the dials? I would imagine that your back would hurt from sitting erect so long and alternating with leaning over while sending. And if you have to retune the receiver or transmitter frequently, as in a contest, your arm will have to be raised to turn the knobs and your shoulder will ache. If the rig is at a certain height, your elbow will bear the weight of the arm that it supports. Lowering the rig might help to relieve some of the physical pressures of operating over extended periods.

Raising the rig has its attendant problems too. If it is too high, the forearm will be supported by the muscles in the upper arm and a lot of weight will be balanced at the elbow. Your arm is like a lever and if the load (the hand and forearm) is long and the opposite side of the lever is short (your upper arm is almost vertical as you sit at the table), muscles in the arm and shoulder will soon ache and the elbow hurts. Lowering the rig to a point where the forearm can rest on the operating desk and knobs can be turned with a thumb or a couple of fingers will help a lot in easier operation. This arrangement also offers the advantage of having the gear next to your hand as your arm and hand are relaxed.

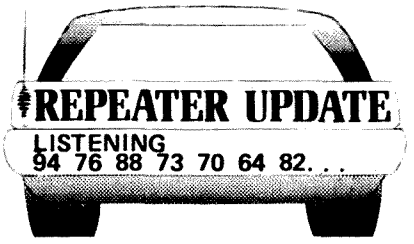
Are you right or left- handed? Do you tune your receiver often? Is the main tuning knob close to the hand that can more comfortably turn the knob? Some receivers have the tuning knob close to the left side of the receiver and if you are right handed, you will have to reach across your body to operate it. By reaching across your chest, you constrict your chest and breathing becomes a little more difficult. It may not be too noticeable at first, but after an hour or two, you begin to feel a little fatigued from cramping your lungs and breathing muscles. If the desk is not too wide, put the less frequently used equipment above but not so close that rising heat causes problems with stability.

Loudspeaker and headphones should be within easy range, the speaker such that it does not send sound to only one ear, and the cans in a position that they can be quickly reached and plugged in. Paper, log, pencil all have their place too. Lighting should be not too strong or weak and preferably it should be indirect, that is, reflected off a wall or ceiling. Avoid glare.

Ham radio is an enjoyable hobby so do not make it physically hard to enjoy it. Station arrangement for convenience and comfort is an art. Think of how much each piece of gear will be used in comparison to each other piece. Are frequently used items handy or buried in a drawer? Taking the time to set up everything for comfort helps to enjoy the art of communication.

And do not place your station in front of a drafty window.

...K1NUN



CT	WA1NQP	Naugatuck	444.2–449.2
CT	WA1KGQ	Vernon	19–79
			52.76–52.525
			443.3–448.3
			221.38–224.38
IN	W9CSF	Michigan City	
	Incorrectly listed in Jan. as W9CF.		
	Recent changes are 1.8 kHz TB or 131.8 Hz PL		
MA	WA1KHB (formerly W1HWK)		
MA	WA1KHC (formerly W1CSF)		
MA	WAMHN	Somerville	07–67
MA	W1RJS	Salem	28–88
	(formerly W1ZAW Beverly)		
MA	W2EMB	Everett PL 88.5 Hz	13–73
MN	KØLAV	St. Paul W1.4	34–94
NJ	WA2ZVQ	Toms River	31–91
NY	K2LEQ	Delete	
OH	W8CQR	Cleveland	16–76
RI	W1HQV	Providence	16–76
TN	W4BS	Memphis	22–76
WI	W9VZR	Milwaukee T2.1	29.440–29.600

Navy MARS repeaters are linking on a coast-to-coast network. The latest information is that they are using input and output frequencies of 148.41–150.09; AF MARS uses 142.155–143.46; and Army MARS uses 143.35–148.01.

Tnx to KØLAV, W1HQV, K9DZE, K1KRY, K3ZQN, K4ZZO, W9BLR, W1GAN, W2EXQ.

When you hear a new repeater on the air, drop us a line and we'll share the news. If you hear of one going off the air, let us know also, please.

National 52 Simplex

The move toward using 52 as a national simplex frequency got support from the repeater groups of the Northeastern U.S. at the meeting of 75 repeater groups in Westchester (PA) and about 50 groups in Shrewsbury (MA) early this year. All agreed to the 52 transceive channel. Add this to the similar agreements in the midwest and you have a movement.

With the hope of encouraging this idea 73 wrote to the manufacturers of FM transceivers and asked that they consider including 52 pairs in their sets in the future instead of 94 pairs. Several manufacturers were enthusiastic about this and as present stocks of the 94 crystals get down to reasonable levels the new 52 pairs should start getting into service. Many manufacturers indicated that their customers have only to write to them and an exchange of crystals can be made at no charge.

To encourage the move to 52 simplex 73 will publish a box score for the next few months listing all sets which will be coming out with the 52 pair.

Why the big push for 52? This should take some of the pressure off the use of 94 as a simplex frequency. The 94 pairs of crystals in sets has resulted in heavy simplex use of this channel in the larger urban areas and this causes trouble with 34–94 repeaters. All you need to do in the New York area is hint at a new 34–94 machine and 94 will turn blue as the emotions pour out, obscuring reason from 88 up to 97 or so.

The fact remains that there are more 34–94 repeaters than any other and they are not going to be wished away by New York or Los Angeles or the other big urban areas.

With the cooperation of crystal companies and transceiver manufacturers the change to 52 can be made during the next few months. Inexpensive crystal pairs for 52 will help. Free exchange of crystals by manufacturers will help. Cooperation will help most of all. Does it really make sense to sound off endlessly about getting repeaters off 94? The view from Jackson Heights (NY) may tell you that just about everyone in the world is using 94 as a transceive frequency and everything would be just great if those crumbs over in New Jersey would just move that repeater in Greenbrook. A look at the repeater list in this issue will tell you the big story of the multiplicity of 34–94 repeaters around the country and the virtual impossibility of getting "all repeaters off 94." Perhaps 52 is the better bet.

Derrick Electronics in Broken Arrow OK will supply crystals for all the commonly available rigs for only $7.75 *per pair*. Converted commercial rigs are slightly more. Derrick is the first supplier to indicate this type of support for a national simplex frequency. Sonar Radio will supply any crystals to the users of their products as substitutes for 34–94 and 94–94.



EDITORIAL BY WAYNE GREEN

OUR PROFILE

It should be no news to amateurs that CB groups have been stealing the thunder from us as far as public service is concerned. The communications provided by a group of CBers with mobile units is fine for most local area situations and in most parts of the country CB has been putting amateur radio to shame.

The size and expense of amateur radio equipment for the low bands has been such that interest in mobile operation has dropped tremendously over the last twenty years. In the old amplitude modulation days a little mobile converter and low powered transmitter weren't a big deal. The converter played through the car radio and worked fine. Then came sideband and a whole new ball game as far as stability and complexity was concerned. And out went wholesale mobile operation as we knew it in the early 50's.

Mobile operation is back, stronger than ever, but it is on two meter FM now and works through repeaters. We have better communications than we ever had before, so how about using it for public service? We can now talk base to mobile to hand unit over a range of about fifty miles from most repeaters, ideal coverage for most local applications.

Okay, we have the facility, how do we swing into gear with it? How can we make this pay off for amateur radio?

The number of events and situations which can use good communications is endless . . . it can be almost any sporting event such as boat races, bicycle races, ski races, cross-country races, car hill climbs, car rallies, parades, telethons, etc. All you have to do is keep your ears open and get the member of your repeater group to keep on watch for opportunities to serve.

Providing service is fun . . . a lot of fun. You'll be right in the middle of what's happening and you'll be working with the people who are running the event. You may find yourself parked in an out-of-the-way spot along with a small team of timers on a rally checkpoint. Your job will be to send the times of the cars passing through the checkpoint back to the rallymaster so he can compute the scores. You may well have to do this for two or three different checkpoints through the day if it is a long rally. The chances are that you'll emerge from this job with a strong interest in rallying.

Serving is fine, but please don't forget that the service is only half of the work. You may be self-effacing and not want to blow your own trumpet over what you've done, but amateur radio needs all the credit it can get so put your modesty aside and let the local papers know what you are going to do, what you are doing and what you have done. Also alert the local radio and television stations . . . get good PR for amateur radio. And . . . please . . . send a copy of the newspaper item to 73 when you get done so we can perhaps make a mention of it in our newspages . . . we send reprints of the better newspages to Congress.

HIGH POWER BASE STATIONS

Repeaters are designed to work with mobile stations running on the order of ten watts. Most of them will give coverage of about fifty miles or so under these conditions. So what happens when someone comes along with a home station running 250 watts plus a nice big beam which steps that up to about the same signal a 5000 watt mobile would put out? Chaos.

A big base station can lift repeaters for a couple of hundred miles around and put several out of business while making a local contact.

If you have a big signal base station please keep in mind that it is within your capability to ruin the fun for a lot of people when you are inconsiderate. Fellows will go along with you on an occasional band opening, particularly if it isn't at the peak operating hours, but don't be in there night after night wiping out repeaters in the next state just because you don't care. Fun is the name of the game . . . fun for as many people as possible. So don't spoil the fun.

PRIORITY INPUTS

One of the grumbles frequently aired by FMers who have come into ham radio via the two-way communications route is that too many base stations take up repeater time and don't let the lower powered mobile stations get a word in. Now and then there is a case where a real emergency comes up and long-winded higher powered ops just won't shut up long enough to let a breaker get through with emergency traffic.

Rather than go the route of freezing base stations out of repeaters, perhaps we might think of the situation in terms of needing more repeaters, not less activity on the ones we have. Until all of the two meter and even the 220 MHz repeater channels are full and active, we do have room for repeater expansion.

Emergencies and low powered mobile entry into repeaters can be solved by setting up a second receiver at the repeater site with a priority hookup so it will override the regular base station input channel. One reader has gone so far as to suggest that a "national" emergency calling channel be set up which would override all repeaters. We could set aside one channel for strictly emergency traffic input and have it take over all repeaters in range, but this would require an awful lot of cooperation on the part of the users to keep the hell off that channel except when the emergency arrives. Perhaps that is too much to ask.

COLLINS KAPUT?

Apparently no decision has yet been made by the Collins management about the future of the amateur radio division. Rumors are, of course persistent that Collins will close down their amateur radio manufacturing.

Collins, once leading the industry with new designs for amateur equipment, seems to have stopped their development about ten years ago at the time of the ARRL petition to the FCC which eventually resulted in the downgrading of most amateur licenses.

This is a far cry from the days when Collins had just brought out the 75A1 and the 32V1 and were busy selling the advantages of sideband to the Air Force. Old-timers will remember the many flights around the world made by Art Collins WØCXX with Mort Kahn W2KR and a handful of other "important" hams made in Air Force planes with Generals Butch Griswald and Curtis LeMay. These chaps talked with their small group of friends on the high end of 20m phone, continuing the "private club" type of ham radio so popular on the high end of 75m during the 30's.

Perhaps this is exaggerated in my mind, but I seem to recall that as part of the effort to sell the Air Force on Collins sideband equipment, their ham gear was installed in just about every-

thing General LeMay had that moved or was around him . . . home, car, plane, boat . . . etc. However the sale was made, it seems to have worked and millions of dollars of Collins gear was bought by the Air Force, or was it billions?

Somehow, though the equipment is the oldest still being marketed for amateurs, Collins equipment still has prestige. It certainly was fine in its day. The cost of redesigning would be very high now and there seems little likelihood that the new Collins management, strapped for cash, would find it worthwhile to make the investment required to continue to sell in the static sideband ham equipment market. FM is the big one in 1972 and in that field Collins would be starting almost from scratch and would be up against those little transistor radio makers from Japan.

What will happen to used Collins prices if the factory closes down the dealer setup? This could have serious effects once parts and repairs are hard to come by.

Being practical about it, there seems little possibility that Collins will continue to make ham equipment. It is sad to see another top name in ham radio go.

* * *

Old-timers do not have any corner on the market when it comes to grumbling about how bad things are in the ham bands. The Nattering Nabobs of Negativism are souring away, badmouthing the inconsiderateness on twenty meters, the lids on six, the base stations who talk at length over repeaters, and so on and on and on.

Perhaps it is the old psychological mechanism known as projection that they are seeing. It is just possible that the reason they are complaining so bitterly is that they are faced with themselves at every turn and don't ever see anyone else. That's enough to turn any stomach.

Is there a pat answer to this? An easy solution?

I think so. The next time you get regaled with sighs and groans about what our bands are coming to, suggest (tactfully) that said griper try finding out a bit about the chaps that he talks with the most. He could make up a set of index cards or a file folder with notes on each regular contact . . . full name, wife's name, names of children, what all of them do, other hobbies of his and his family, places he has visited, what equipment he has and maybe what he is thinking of getting, notes on any interesting yarns he has told, what other ham interests he has, bands he works.

Such a file will serve several purposes. Getting the information will result in some of the most interesting contacts the other fellows have ever had . . . and they will comment on this. People like talking about themselves more than anything else in the world. Your curmudgeon will soon find that, once he knows more about the chaps he has been talking with, he will enjoy the contacts a lot more. They will be with people, not just call letters.

Can this system fail? Probably, but you'll have to prove it to me by trying it first.

73 TOUR OF EUROPE IN SEPTEMBER

How would you like to walk around Moscow with a transceiver and work a bunch of amateurs over there with you on a tour? Special permission has been requested to permit U.S. amateurs to visit Moscow this fall and bring along their two meter transceivers . . . plus permission for 73 to bring along a complete small repeater unit and set it up so we can all keep in touch from anywhere in town. Will that be fun?

The trip is scheduled to start September 4th from New York and fly first to Copenhagen . . . Tivoli amusement park will be open . . . some of the finest restaurants in the world . . . and REAL Danish pastry . . . or would you rather take a look at those sex shops? We'll arrange for you to meet Danish amateurs and visit with them . . . perhaps a nice hamfest and party. We expect no problems setting up a repeater here . . . nor with getting permission for all of us to operate.

The second stop will be Berlin, with organized tours (if you like) of both East and West Berlin. Other than this there will be no organized tours. You will be flown to a city, taken to a nice hotel, and provided with breakfast . . . from there you are on your own. We'll recommend restaurants . . . get you in touch with local amateurs . . . and give you the benefit of our experience.

The third stop will be Moscow where we will meet many of the local amateurs . . . and have a party with them. We hope to arrange it so those interested in working DX will be able to operate some of the club stations and talk back home.

The last stop will be Amsterdam . . . more amateurs . . . hopefully a party . . . and more two meter fun, probably with our own repeater.

The trip will last three weeks and will be something you will remember the rest of your life. Nothing like this has ever been done before . . . how about coming along?

In order to keep the price of the trip as reasonable as possible we will be staying at good hotels, but not posh ones. We have always found that the smaller hotels are much more friendly and fun . . . better food . . . better service . . . and an interest in you. You can have the snob places where the desk clerk has a permanent sneer.

The whole trip, based upon double occupancy of rooms, with bath wherever possible, including all air and land transportation, airport taxes, breakfasts, parties, is expected to run about $700 each . . . $1350 for two.

If you like the idea and want to reserve a spot on this trip you may send in a check for $200 down payment for each ticket. This is refundable in full up until 60 days before the trip and in part after that. Final payment will have to be 60 days before departure. Please sign up early so we will be able to handle the amateur radio license registrations and permits for the four countries. We'll send you crystal information for your transceivers to match our portable repeater as well as the many repeaters now on the air in Europe.

Three solid weeks with Wayne Green? Lordy!

. . .W2NSD/1



NEW PRODUCTS

NEW GE VARISTOR

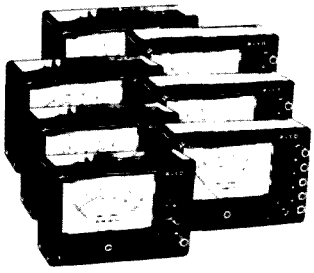
Voltage surges burning up your transistor projects? Need some kind of protection on an IC that is easily ruined by excessive voltage? The answer to the problem is the new GE-MOV varistor made by General Electric. By mounting this device in parallel with the delicate components or circuit the MOV acts as an insulator until a voltage surge occurs. Then the MOV becomes a conductor and the power is safely bypassed from your circuit. The MOV, short for metal oxide varistor, can be used for protection, stabilization, or regulating voltages to components like ICs that can melt with too much voltage. As technology advances, these devices will find greater acceptance in the homebrewer's shack, but in the meantime, they will be used in industrial applications such as TV, relay and motor protection, and other places where solid state controls are found. We'll be hearing more about this in the near future. Contact the *Semiconductor Products Dept., General Electric Co., Building 7, Mail Drop #49, Electronics Park, Syracuse NY 13201.*

(continued on page 12)

NEW PRODUCTS

Continued from page 11

SINGLE FUNCTION METERS



Experimenters will really like the new single function meters made by ALCO. These meters have multiple ranges, but each is made for only one function (i.e., dc microamp, dc milliamp, dc amp, dc volt, ac milliamp, ac volt, and ac amp). Each meter has a wide face, making reading easier, and the accuracy rating is 1.5%. Low cost makes these easy to own, as the average price per meter is about thirty dollars. Write to *ALCO, 1551 Osgood St., North Andover MA 01845.*

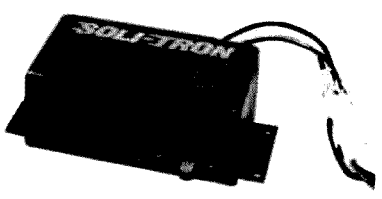
NEW 220 TRANSCEIVER

CLEGG 21er: the first 220 MHz FM transceiver offering the operating features and quality performance that FMers have come to expect on lower frequency bands.

The 21er provides automatic panel selection of ten primary crystal controlled transmit-receive channels and secondary continuous tuning of the 220 MHz FM band. The 21er provides a conservative ten watts output combined with a .25 μV receiver with the ruggedness and reliability of an extruded frame and diecast panel structure.

Scheduled for production in June, the 21er will be priced under $300. Also planned for early release are 220–144 MHz receiver converters and 220 MHz repeater package.

6–12 VOLT DC CONVERTER



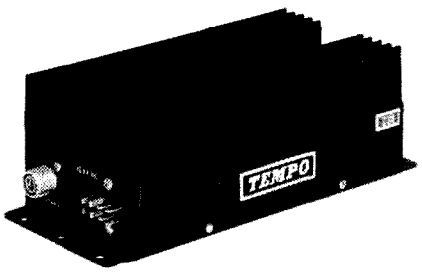
Solitron Devices, Inc., announced the release of a 6–12V dc converter for use with vehicles having a 6V negative ground system. The converter will step up a 6V dc source to 12V dc for use with the newer electronic accessories now available for the higher voltages. The converter can be used to supply 12V dc for use in powering AM-FM radios, auto stereos, tape deck equipment, amateur communications equipment, and other accessories.

The converter also has 6 amp output – continuous, a switch and pilot light to insure converter is working, puts out up to 72W, has a one year warranty, and fits conveniently in trunk area or under dashboard of vehicle. For further information contact *Solitron Devices, Inc., 256 Oak Tree Road, Tappan NY 10983.*

LOW COST I.C. POWER SUPPLIES

Viking Electronics, Inc. has introduced a line of low cost power supplies for logic and linear system applications. Priced from $17 to $24 in single quantities, the OEM 70 Series provides typical outputs of 3.5 to 6V @ 3 amp, 8–15V @ 1.2 amp with regulation of .5 to .1% and ripple of 1 to 2MV dependent on models. Features include electronic current limiting, floating output, stable differential amplifier circuitry, silicon transistors and computer grade capacitors. For more information contact *VIKING ELECTRONICS, INC., 721 St. Croix, Hudson WI 54016.*

IMPROVED TEMPO FM AMPLIFIER



In January we reviewed the Tempo 100 watt amplifier . . . just in time to find that a new model had been released which was even better in almost every way!

The Tempo amplifiers are made by TPL Communications in Hawthorne, California, not in Japan like the Tempo FMV transceiver. They were formerly made by C.T. Power, but the company was reorganized and now is owned by Tom Litty K6RAD, a young designer from TRW, the company that makes most of the power transistors used in the power amplifiers on the market today.

The new 120 watt amplifier has printed circuit coils, with about the only things sticking up at all being small lumps for the driver transistor and the three parallel output transistors, some flat by-pass capacitors and small tuning capacitors. With 10 watts in you definitely do get 120 watts out – this is exactly what I measure in my car using the Standard 826M as a driver. It does make a difference too! With the ten watt signal I can generally lift repeaters that are coming in an S-4 or so the 120 watts puts me through repeaters that are less than S-1, but still are readable

If all of my contacts were made parked on the top of my nearby mountain, I wouldn't have much use for the higher power. But one of the problems of living in the mountains is that most of the time I am driving with a mountain between me and the repeater I am talking through. This is where the power helps a whole lot. After all, if I can hear the repeater, why shouldn't I use enough power to get into it from wherever I can hear it? That seems reasonable to me and the 120 watt Tempo does this job beautifully.

Tom has added some other extra to the new amplifier; little plus details. There is now a jack for plugging in a control switch to turn the amplifier on and off, keeping down your battery drain when the extra power output isn't really important. Once your repeater is coming in over S-6 or so you probably won't need the pair of shoes and your car may appreciate holding onto the 17 amperes.

Perhaps it's a small thing, but I appreciate the addition of a power output plug instead of a cable hanging out with a UHF connector on it. Once the unit is in place under the seat of my car it doesn't make any difference, but when I go to take the amplifier out for a trip (I take it with me when I fly and use it in rented cars), it greatly simplifies the change.

The TPL amplifiers were on display at SAROC and were one of the hits of the show! The wattmeter used for the demonstration showed that the amplifiers were rated conservatively and that 140 watts out of the 120 watter was not uncommon.

The promised 220 MHz TPL transceiver drew much attention too and is due to be produced soon. The company reorganization put them back a few weeks. There are, I understand, well over 200 back orders for this unit, so perhaps we will start seeing serious 220 activity in the near future. The most important product promised from TPL is a 220 MHz repeater. Once that is available we can start populating the band in earnest. I look forward to the day when virtually every repeater club has a 220 MHz repeater as well as one for two meters.

TPL has quite a wide range of amplifiers for two meters, six meters, 220 MHz and 450 MHz. Their two meter amplifiers are designed to work with any of the commercial transceivers, from the one watt output Drake TR-22 up to the 25 watt Gladding and Simpson units. They even have an amplifier that will lift the TR-22 to 100 watts out.

Distributors would do well to contact Henry about handling this line of equipment.

W2NSD/1



The Radio Association of Erie, on April 8, will hold its annual Ham Auction at the St. George's Gym. The auction starts at 2:00, and it is expected to be a good one. The gym is located 1½ miles north of I-90 on U.S. Route 19. Free map and details from RAE Auction, Box 844, Erie PA 16512.

* * *

The Southern Tier Radio Clubs are sponsoring their Thirteenth Annual Hamfest for April 15 at the St. John's Ukranian Hall, Johnson City NY at 2 P.M. For tickets and additional information, contact John Pike WA2UKS, 635 Lacey Dr., Endwell NY 13760.

* * *

The Delaware Amateur Radio Club will hold a Horse-Trader and Auction night at the County Engineering Bldg., Kirkwood Highway, Wilmington, Delaware on Wednesday April 12 at 8 P.M. Bring your gear and sell or swap. For further information contact Charles McGonigal WA3AVD, 18 Harvard Road, Wilmington DE 19808.

* * *

The Fresno Amateur Radio Club presents Fresno Hamfest '72 on April 28, 29 and 30. There will be swap tables, transmitter hunts, displays, banquets and more. The convention will be held at the Fresno Hilton. Listen in on 7255 WCARS and 3952 WPSS, or write to Fresno ARC, P.O. Box 783, Dept. HF, Fresno CA 93712 for more information.

* * *

The Rockaway ARC will hold its Annual Spring Auction and FMers Get Together Friday evening April 28, 1972 at 8:00 P.M. at the Hall of Science, 111th St. & 48th Ave., Carona, N.Y. at the old World Fair grounds. Doors open at 6:00 P.M. to accept items for the sale. Two dollar donation at the door will include refreshments. For further information contact Auction Chairman, Al Smith WA2TAQ, P.O. Box 341, Lynbrook, N.Y. 11563.

* * *

Southwest Ham Round-up and Fiasco will be sponsored by Old Pueblo Radio Club April 29–30, 1972. Headquarters Ramada Inn, Tucson AZ. Banquet, technical sessions with ham applications and demonstrations. Ladies, luncheons and tours. Pre-registration prize plus other prizes. Swapfest, auction, and other activities on the 30th. Plan to enjoy the hospitality and fun in the sun. Contact Al Summers W7MGF, Chairman, c/o O.P.R.C., Box 6497, Tucson, Arizona 85716.

* * *

The Young Ladies Radio Club of Los Angeles will hold its Sixth International YLRL Convention. Tours, cruises, talks, meetings, and entertainment will fill the long holiday weekend of May 26, 27 and 28. The convention will be held at the Edgewater Hyatt House on Pacific Coast Highway overlooking the Long Beah Marina. Registration of $12.50 goes to $14.00 after May 15. Further information can be obtained from the Convention Committee, P.O. Box 3092, Long Beach CA 90803.

* * *

The Fresno Amateur Radio Club presents Fresno Hamfest '72 on April 28, 29, and 30. There will be swap tables, transmitter hunts, displays, banquets and more. The convention will be held at the Fresno Hilton. Listen in on 7255 WCARS and 3952 WPSS, or write to Fresno ARC, P.O. Box 783, Dept. HF, Fresno CA 93712 for more information.

GEORGIA QSO PARTY

Starts: 2000 GMT, Sat., May 13, 1972.
Ends: 0200 GMT, Monday, May 15, 1972.

The eleventh annual Georgia WSO Party is sponsored by the Columbus Amateur Radio Club, Inc. There are no time or power restrictions and contacts may be made once on phone and once on CW on each band with the same station. Each complete contact counts 2 points. Georgia stations multiply their total QSO points by number of different states and Canadian provinces worked. DX stations may be worked for QSO points but do not count as multipliers. Out-of-state stations will use the number of Georgia counties worked for their multiplier (a possible total of 159).

Write to CARC, Inc., Attention: John T. Laney K4BAI, P.O. Box 421, Columbus GA 31902 for full information on the contest.

MARYLAND

Potomac Area Hamfest will be held at Westminster, Maryland, on Sunday, April 30th, 9:00 to 5:00. $2 registration covers flea market and tail-gate sales. Professional food and beverage catering on grounds. Parking for 400 cars. Usual hamfest activities. FM talk-in on 146.94. Details from K3LNZ, K4LHB or W3EVF.

1972 NEW YORK STATE QSO PARTY

This contest is open to all amateurs and SWL's in the world.

Times: 1700–0500 April 29 through April 30 GMT; 1200–2350 April 30 GMT.

Calls: In State: CQ NY TEST; out of State: CQ NY.

Exchange: QSO number, RS(T), QTH – out of state stations use ARRL sections; NY stations use counties.

Scoring: Score one point per contact on 80 10; two points for each 160, 6, or 2 meter contact; times number of multipliers.

Logs must contain date and time, band, mode, station worked, QSO number, QTH. First new contact for each multiplier numbered.

Certificates will be awarded to top scoring station in each ARRL section, country, and NY county. Special Novice and Technician certificates will also be given. Second and third place awards will be issued at the discretion of the contest committee.

Logs, comments, photos, etc. should be sent no later than June 1 to LERA ARC Contest Committee, Jeff Ronner WB2AEQ, 35 Gottlieb Drive, Pearl River NY 10965. Stations planning operation in NY are urged to contact LERA so they can plan for coverage of all counties.

THE FOURTH RTTY WAE DX CONTEST

RTTY WAEDC '72

The Deutscher Amateur Radio Club (DARC), the sponsor of the RTTY WAEDC, and the Deutsche Amateur Fernschreib Gruppe (DAFG), the manager of the RTTY WAEDC, have the honor to invite RTTY amateurs all over the world to participate in the 4th RTTY WAE DX Contest 1972. This contest is always held on the last weekend of April.

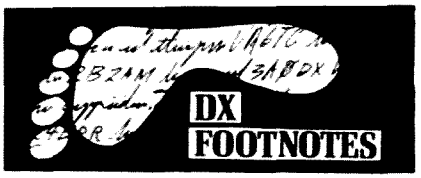
1. CONTEST PERIOD: April 29, 0000 GMT to April 30, 2400 GMT.
2. CONTEST CALL: CW WAE de . . .
3. SCORING: The final score is the total QSO points plus QTC points multiplied by the sum total countries from all bands.

Contact WAEDC officials for further information: *WAEDC - Committee, D-8950 Kaufbeuren, P.O. Box 262, Germany - West.*

COLUMBUS GEORGIA HAMFEST

The fourteenth annual Columbus, Georgia, hamfest will be held on April 9, 1972 at the Fine Arts Building behind the Municipal Auditorium at the Fairgrounds. For information, write J. T. Laney, K4VGI, 1905 Iris Drive, Columbus GA 31906.

(continued on page 14)



According to the *Mobile News* the Journal of the Amateur Radio Mobile Society, the following members have attained new status in the Mobile Century Award Listings: W6KZL/m 236, F3DJ/m 221, G3BID/m 201, SM5RQ/m 190, DL6UH 160, W4NEW/m 140, G3TJY/m 121, WA3HDU/m 108, G3KNB/m 103, WA4WTK/m 102, and DJ3LF/m and WA2FQG/m, 101 apiece.

Gus reports in the DXers Magazine:

W3QLW has received the Arabian Knights certificate which states on a beautiful document, "The Arab Radio Amateur League has the pleasure to certify that Mr. Oscar G. Herrick, W3QLW, has contacted ten Arab countries and has been granted the Arab Knight award in significance of being a dear friend to all Arab Radio Amateurs. League Chairman (signed Hussein, JYL) Date 30 Sept. 1971 No. 27."

C31DP will be active for three weeks in June, so says Omer ON5TO who should know; it is his second call.

Between Ed, W8KGR, and Guy, TR8DG, the French Community Net is handled very well. The net meets on Mondays and Wednesdays at 1930Z on 21,390. Plans are to increase activity to four days per week operation and they want many check-ins.

If you are looking for TN8BK, try around 1400Z near 21,330 up. As a doctor, Bernard does not have too much time for operating.

Les, ZD9GA, has been active from Gough Island on 20 SSB. Most of his operating seems to be list type work. QSL via ZS2RM.

7X2BK has been heard on 20 SSB, around 14,236 about 2000Z. Listen carefully as he is using transceive and an indoor antenna.

Every Wednesday Robert, 9U5CR, holds skeds with his QSL manager Omer, ON5TO, at 1800Z on 14,280. He is QRV for others after they are finished.

Tapei is active now that BV2AB, Bob, is on the air. He is the first American to be licensed there in several years. Look for Bob 14,230 from 2300 0130Z. Sends QSLs via K4ASI.

Contact Mary, WA3HUP, if you need help in working CR3KD on Portuguese Guinea. They have skeds twice a week on 15 and 20.

Nauri Island, C21TL, can be found 14,200. This station will be on the air for about three years. FB8ZZ, on the other hand, will only be active for another month or two. FH8CG can be heard near 21,285 about 1700Z. And FM7AA is at 14,222 about 1240Z.

JX2HK has been worked on 14,038 about 2000Z. This is Jan Mayen Island.

* * *

From CARF, we learn that . . .

ONTARS – Ontario Amateur Radio Service has commenced operation on 3775 kHz. Hours of operation are from 7 AM to 6 PM E(D)ST, daily. This is a call-in net similar to ECARS on 40 with the prime object of providing two-way facilities during the daylight hours throughout Ontario. Congraulations go to the Radio Society of Ontario for sponsoring the net and to Bruce Carveth VE3BC, ONTARS net manager.

* * *

And from the West Coast DX Bulletin .

An international group claims to have established an away-from-it-all republican state on the desolate sea-washed Minerva Reefs in the Pacific about 450 miles south of Fiji. Fiji has been asked to recognize the state, established by the self-styled Ocean Life Research Foundation of New York and London. Two dredges are due to arrive at the reef in three weeks to begin reclaiming up to 400 acres of land on Minerva. Mark Oliver, a U.S. Citizen who said he is one of the three directors of the foundation, said in Suva their intention was initially to build a port and later a sea city as a haven for people who wanted to escape from crippling taxes, riots, crime and drug addicts. "We decided on Minerva after a worldwide search because research showed conclusively that the reefs do not belong to anyone," he said. "By International Law one can claim by annexation only land above the sea that can be built upon. We have met this requirement by constructing two small islands of coral and sand on the reefs." Oliver said the Ocean Life Research Foundation, established 18 months ago and backed by scholars throughout the world, was serious about a sea city republic at Minerva. International engineering companies had been consulted and expenditures on the project, so far, totaled $180,000, he added.

* * *

QSLs for 3D6AO, Swaziland, may be sent to P.O. Box 1, Mhlume Tshaneni, N.E. Swaziland.

Nigerian Amateur Radio Service and Joe, 5N2AAJ only accept incoming QSL cards for Togo, 5VZ and TJ and they are not responsible in any way for outgoing QSL cards. All incoming cards are passed on to 5VZ immediately and after that their responsibility is ended.

The Liberian Radio Amateur Association sponsors a West Africa Net on 7060 at 0800Z each Sunday. So far 9G1, E12, 9L1, and 5V7 have joined in.

* * *

Some of the current active "DX-pedition of the month" stations: HP1IE/3F1IE, JW1EE, KF4SJ, PJ7VL, VA2UN, VK9JK, VK9XX, VK9XK, VP8JV, VS6DO, VS6DR, and 9Y4VT.

* * *



MCAS IWAKUNI, Japan, Oct. 5 — Captain James W. Jackson is a quiet man, but his voice has been heard all over the world. The 32-year-old native of Rochester, N.Y., operates KA5JJ, the only authorized amateur radio station here. Captain Jack-

SOCIAL EVENTS & CONTESTS

(continued from page 13)

7th WORLD ORCHID CONFERENCE AMATEUR RADIO CONTEST

The contest has been organized by the "Liga Colombiana de Radioaficionados, (Zona 4a) and is sponsored by the 7th World Orchid Conference. It begins at 0000 GMT, Saturday, April 8, 1972 and ends at 2400 GMT, Sunday, April 9. AM and SSB in phone only. 5J4LR and 5K4LR will also be on the air. Multi-operator stations not allowed. Exchange: HK4 stations, RS plus a 3 figure number indicating the power of the station. Other stations, RS plus a 3 figure contact number, starting with 001.

Points: For stations not in North, Central or South America – contacts with HK4 stations, 5 points, contacts with 5J4LR or 5K4LR, 10 points. For stations in North, Central or South America – contacts with HK4 stations, 3 points, contacts with 5J4LR or 5K4LR, 5 points.

The same station may be worked on each band for multiplier credit.

Final score: the result of multiplying the total number of points by the number of bands worked.

Mailing deadline: June 9, 1972, to: LCRA, Seccional Medellin, Apartado aereo 51900, Medellin, Colombia, South America.

LETTERS

I read with interest your editorial in Jan. 72 issue of 73. I fully agree with you that the amateurs made a big mistake by operating their repeaters with only .6 MHz spacing. The problems encountered at 1 MHz is a fraction of problems and cost involved with cavities and duplexers.

Let's not get ourselves into the same fix when we go fully duplex. The phone company operates mobile duplex with a frequency spread of 5.26 MHz in the 150 MHz range. It is possible to make mobile duplexers extremely small to fit right inside the mobile. "Systcoms" duplexer measures only 4 x 3 x 1½ in. for telephone applications. The two meter hand has a 4 MHz spread so why not use 3.5 mHz spacing and 220 has a 5 MHz spread so why not use 4 MHz spacing. Someone may come up with the argument that the spread is too great if you want to operate simplex also. The answer is the mobile manufacturers are learning how to broadband amplifiers so operating a transmitter over a 1 MHz range is possible. Recently I evaluated an IC-20 and found that the transmit power dropped only about 15% with two channels separated by 3 MHz. Let's get on duplex the right way. The same desensing and noise problems we are having now with repeaters will occur if we operate mobile duplex with a close spacing.

Some frequency coordination is required now before it is too late.

Vern Epp
Nelson BC

Other opinions on input and output spacing are invited. If we had it to do all over again, would we do it this way? Let's plan 220 and 450 with the wisdom of past learning.

son, assigned to Marine Wing Headquarters Squadron (MWHS)-1, 1st Marine Aircraft Wing, explained that KA5JJ is operated with equipment on temporary loan from MCAS Special Services, and some home-made items. The station, officially named an Auxiliary Military Radio Station (AMRS), broadcasts international Morse code. Although it has voice capability, Capt. Jackson chooses not to use it.

Permission to operate aboard MCAS Iwakuni was granted by the commander of U.S. Forces in Japan, through the commander U.S. Naval Forces Japan, and the commanding officer of MCAS. It was granted on the basis of Capt. Jackson's advanced class operator and station licenses, issued by the U.S. Federal Communications Commission.

Twenty years and nearly $6,000 have gone into a station he owns in the U.S., from which he broadcasts both voice and code to such countries as Russia, China, Chile, France, Sweden, and many others. Jackson moves the equipment with him when he is transferred within the U.S.

"Language is not that much of a problem," he states. "Most amateurs throughout the world know how to give their call sign, location, name and other important information in English."

Capt. Jackson is credited with helping to set up the MARS network in the Republic of Vietnam. While he was there, he conducted classes on amatuer radio operation.

RACES FREQUENCIES

In regard to your editorial concerning repeater frequencies, I feel you are on the right track. Something else you might consider would be to match these channel frequencies with the authorized RACES frequencies. We can hope never to be confined to these frequencies, but this could help improve the status of amateur radio. Also, it could conceivably make available some ideal repeater sights.

Keep up the good work.

Van. A. Sears WA4SQS
Columbia SC

How do other people feel about synchronizing standard repeater channels with RACES frequencies? There is a lot to be said on both sides.

CORRECTIONS AND AMPLIPICATIONS

Modified Heathkit HW-16 CW Xcvr page 101, Feb. 1972 – caption under Fig. 1 should be under Fig. 5 and vice versa. Also caption under 2 should be under Fig. 4 and vice versa.

John Edgerton WA3PRV
New Castle DE

Re - CKT Page 98 (Feb. 73 Mag) - "Variable Power Supply" by W4IOI. Please note - 100K pot - if set to minimum, shorts out basic 320V supply. "Come on guys, you can do btr than that."

Cliff Whipple W5VRT
Morgan City LA

No we can't.

REVISED MORSE

Some years ago a musical genius developed and patented a piano keyboard with a system of tiered tabs that was the acme of simplicity. No black notes for the fingers to slip off of, fingering was standardized regardless of what key the pianist was playing it.

It doesn't require much thought to figure out why this invention is gathering dust in the files of the patent office, and I venture to say that a revised Morse code, patented or not, would suffer the same fate for the same reason.

Harry Sorensen W7IH
Friday Harbor WA

HELP WANTED

I am a student anthropologist taking an anthropological look at ham radio for my Senior thesis. My goal is to provide the public (both college and community) insight into the people who make ham radio what it is – the hams. I need your help.

Here is your chance to sound off. Just write me a letter and tell me about your hobby – ham radio. You can tell me things like what you like to do best within ham radio (DXing, phone, CW, nets, etc.), what you think the ideal ham should be like, what you think of your fellow hams. Tell me about your equipment. If you're a phone man, how do you feel about CW, SSB, AM, or if you're a DX'er how you feel about AM, etc. What do you think of the ARRL? The FCC? How long have you been in ham radio? Do you buy gear or make it? What are your favorite bands? Do you belong to a net . . . club . . . which ones? What do you think of CB'ers? Just tell me about anthing you can think of that you'd like to talk about on the subject of ham radio.

I assure you that (1) I am a genuine anthropologist doing bona fide research with the approval of the ARRL, and (2) your names will be held in the strictest confidence and (3) I'm not some salesman or kook trying to get your names for a mail order firm. In fact, you don't need to sign your name or give me your address; just be sure that if you write that you state whether you're a ham and what license you have. This is very important for my data.

With your cooperation I hope to confirm some of the generalizations that I have made in my research. In fact, I may even have to confirm that no one great generalization can be made about hams! With your information I hope to get an overall picture of the people that are ham radio.

Thank you very much for your time and attention.

David Silver WN1PLC
Box 545, Troy NH 03465

Send your comments to David Silver, Franklin Pierce College, Box 885, Rindge, NH 03461.

Caveat Emptor?

Price – $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor . . .

HALLICRAFTERS SX-115 Receiver, Johnson 275w Matchbox/Swr, Johnson TR switch, Knight T150, PH Linear LA400c. Bud Johnson K1HGK, 48 New Searles Rd., Nashua, N.H. 03060.

GREATER BALTIMORE HAMBOREE. Sunday April 9 at 10 A.M. Calvert Hall College, Goucher Blvd. and LaSalle Road, Towson, Maryland 21204. (1 mile south of Exit 28 Beltway-Interstate 695) Food Service, Prizes, Flea Market, $1.50 Admission, NO TABLE CHARGE OR PERCENTAGE.

BUY OR BORROW for copy Tech. Manual for Corps of Engineers, 5kw. Engine Generator Unit, Hollingsworth Model EA-536, Stock List No. SNL 17-4780. 525–25. Will pay premium. W5BOY, 365 W. Saxet Drive, Corpus Christi, Texas 78408.

WANTED – Bird Model 43 wattmeter elements: 100–250 MHz one 5 watt and two 25 watt, 200–500 MHz one 10 watt. State condition and price. Technical Editor, 73 Magazine, Peterborough NH 03458.

WANTED – Tektronix Model 53/54C or Model CA or M scope plug-in. State condition and price. Technical Editor, 73 Magazine, Peterborough NH 03458.

TECH MANUALS – $6.50 each: R-388/URR, R-389/URR, R-220/URR, SP-600JX, URM-25D, BC-639A, TS-497B/URR, TS-34A/AP, OS-8E/U, BC-348JNQ, BC-779B, CV-591A/URR, LM-21, R-274/FRR. S. Consalvo, 4905 Roanne Drive, Washington, DC 20021.

WANT CLEAN COLLINS 51J-4, also Drake C-4; with manuals and original shipping containers. No junk! First letter give each serial number, condition, price; also price for both, if have both. Watson, 700 West Willow Street, Long Beach, CA. 90806.

GONSET COMM. IV 6M. "factory closeouts" with P.T.T. mike, AC, DC cords. Last ones Gonset will make. Only $169.00. Communications World, Inc., 4788 State Road, Cleveland, Ohio 44109.

SWAN 260 XCVR WITH MIC, ac/dc supply, mobile ant, mobile mount 4btv vertical, 15mtr beam $350 (603) 524-0716.

FOR SALE: Galaxy Station GT550 with accessories SC550, AC400, CAL-25, F3 CW filter, VOX35C. $450.00. Fine condition. John Ivanisko, 5 Clover St., Yonkers, N.Y. 10703.

EVANSVILLE, Indiana HAMFEST 4H Grounds (Highway 41 North 3 miles) Sunday, May 7, 1972; air conditioned, auction, overnight camping, ladies' bingo, reserved flea market booths. Advance Registration. For flyer, contact Morton Silverman W9GJ, 1121 Bonnie View Drive, Evansville, Ind. 47715.

ROCHESTER, N.Y. is again Hamfest, VHF meet and flea market headquarters for the largest event in the northeast, May 13th. Write WNY Hamfest, Box 1388, Rochester, N.Y. 14603.

HAMFEST-WABASH COUNTY Amateur Radio Club's Fourth Annual Hamfest Sunday, May 21. Rain or shine. Admission is still only $1. Flea Market – no setup charge, tech. talks, bingo for XYL's, and much more. For more information write to Bob Mitting, 663 N. Spring St., Wabash, Indiana 46992.

MOULTRIE AMATEUR RADIO KLUB, 11th annual Hamfest, Wyman Park, Sullivan, Illinois – April 30, 1972. Indoor-outdoor market. Ticket donation $1.00 in advance – $1.50 at the gate. Open 8:30 A.M. W9BIL 146.94mhz. M.A.R.K. Inc., P.O. Box 327, Mattoon, Illinois 61938.

21ST ANNUAL DAYTON Hamvention will be held on April 22, 1972 at Wamplers Dayton Hara Arena. Technical sessions, Exhibits, Hidden Transmitter hunt, Flea market and special program for the XYL. For information write Dayton Hamvention, Dept. S, Box 44, Dayton, Ohio 45401.

2-METER FM INOUE IC-10, Brand New, 1 & 10 watts, solid state, 12 channel, w/Etals, w/accessories, $235.00, Bob Brunkow 206-747-8421, 15112 S.E. 44th Bellevue, Washington 98006.

FCC "TESTS–ANSWERS" . . . Original exam manual for First and Second Class License. –plus– "Self-Study Ability Test." Proven! $9.95. Satisfaction Guaranteed. Command, Box 26348-S, San Francisco 94126.

WARREN ARA'S FAMOUS HAMFEST, now family style, Aug. 20, Yankee Lake, Ohio. Gigantic flea market, swimming, picnicking, playground, all free. Camping available. Details: QSL W8VTD.

WANTED Motorola T1020A frequency/deviation meter – state age, condition and price. Technical Editor, 73 Magazine, Peterborough, N.H. 03458.

RUN SAWS, DRILLS, LIGHTS and many other items from 12v to 120v Auto Electric Power Converter. Hook to your car or truck alternator. Has 2 outlets and voltmeter. All instructions. 3¼ x 8 x 2½ metal case. Send $14.95 plus $1.00 handling to: Phil Bowers Associates, 71 Beechwoods, Wakarusa, Ind. 46573.

BUYING? SELLING? TRADING? Don't make a move until you've seen our new publication. Free Sample copy! Six issues $1. HAM ADS, P.O. BOX 46-653P, L.A., Cal. 90046.

HEATHKIT HX-10 MARAUDER SSB transmitter, professionally wired, no mods, mint condition, $150.00. WA8SYC Henry Parise, 1861 Lexington N.W. Warren, Ohio 44485. Ph. 216-395-4938.

EXHIBITORS – Reserve space now for ARRL Hudson Division Convention, Oct. 21–22, Tarrytown, N.Y. Contact Hank Frankel, WB2DQP, Box 535, Bellmore, N.Y., 11711. Phone 212 394-5257.

ALUMINUM ANTENNA MASTS, 9½' long x 3" dia., x 3¼" dia. at base (sleeve 6" long over end). Painted green. 20 lbs. Unused. Very heavy duty. Can be telescoped with short insert. Ideal for Field Day. Pickup preferred. $9.75 each. K3MNJ, 8361 Langdon St., Phila., Pa. 19152. Tel: 215-RA5-2373.

NEED OLD ISSUES or copies of A.T.V. Experimenters, A5 Magazine or any magazines on A.T.V. State price 1st letter. Gerald Cromer K4NHN, 1014 Summerland Dr., Cayce, S. C. 29033.

14AVQ VERTICAL, nearly new – $25.00; Hornet 3 element tribander with manual, fair condition, recently dismantled – $25.00; both $40.00 –,WA4TST, 507 Pinecone, Waycross, Ga., 31501.

FOR SALE: Back issues 73, 1962, 1963, 1964, 1965, 1966 and later. Send SASE for list. Ray Helmick, 1423 Spring, Parkersburg, WV 26101

HEATH SB-200, extra set of finals $190 or trade for 2mtr FM mobile. Swan 240, AC power $70. Will ship. R. Lloyd, 705 B Whiting Ave., Albany, Ga. 31701.

Jack Townsend W4RIZ
124 S. Douglas
Wilson NC 27893

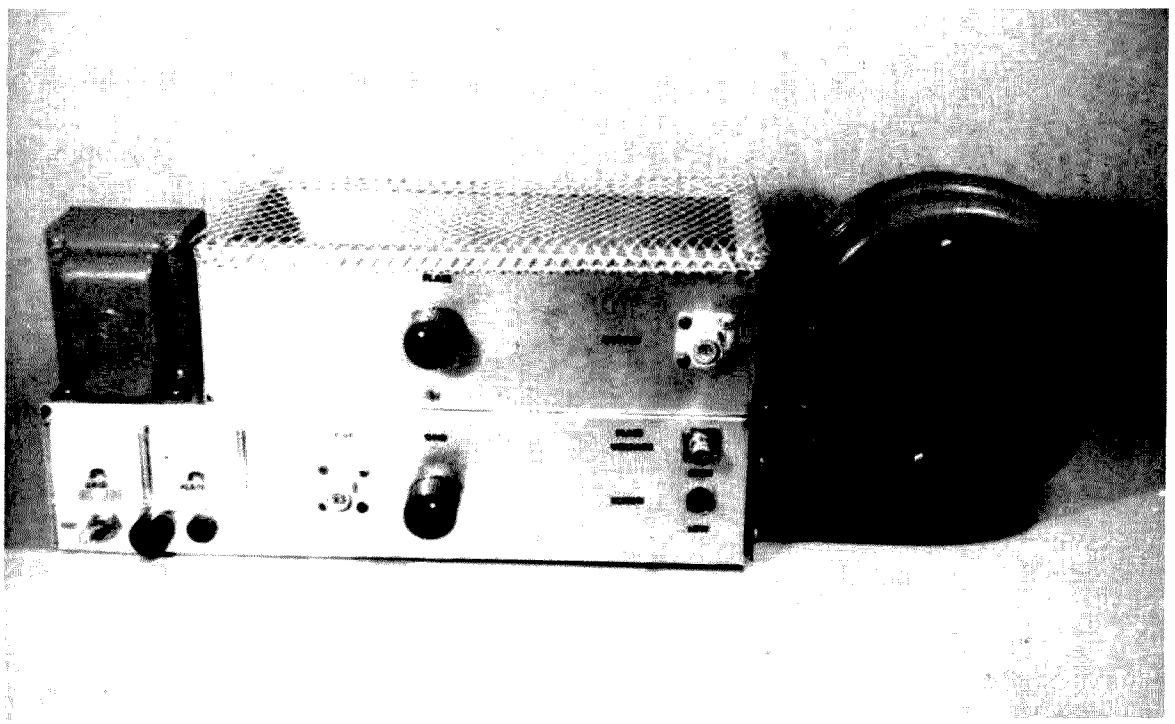
Power Amplifiers for Two Meter FM

A simple and compact power amplifier to boost transceiver output

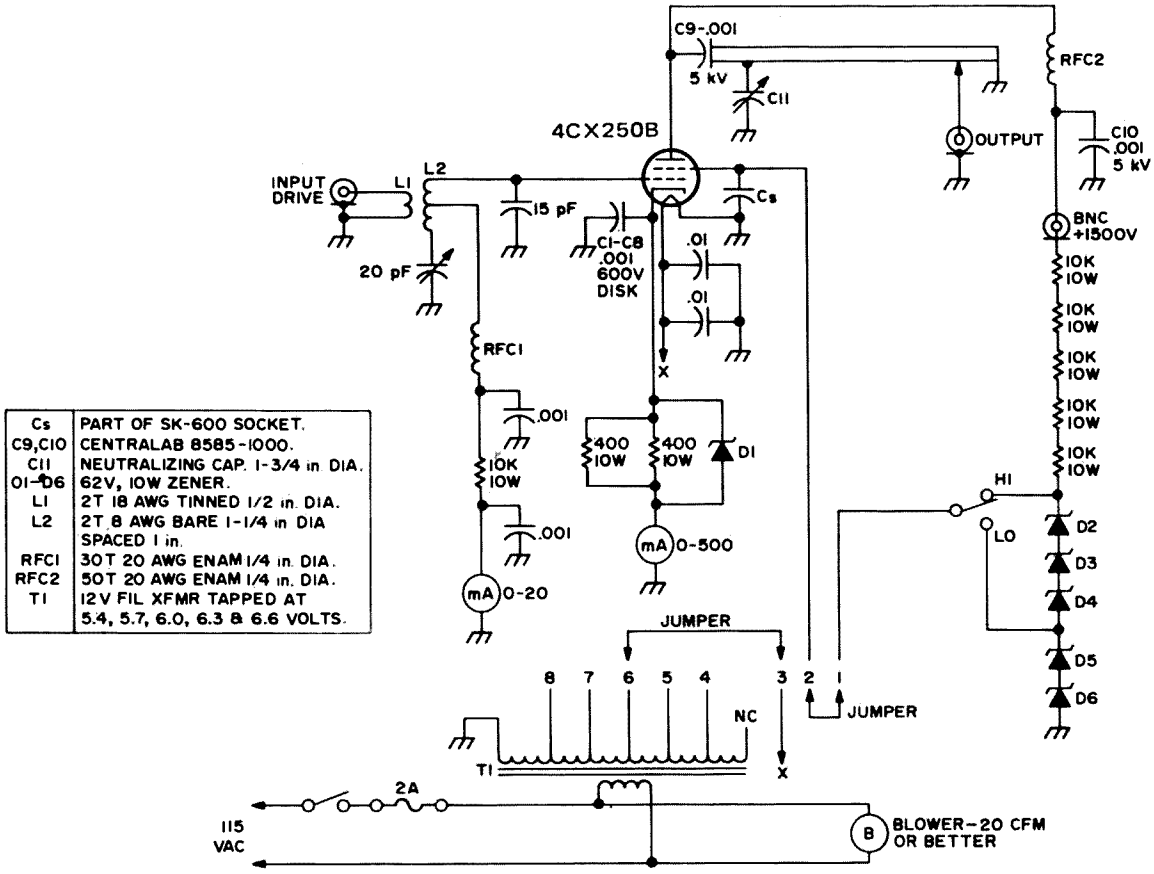
With the increased popularity of 2m FM has come an increased need for additional power to boost the range of surplus FM transceivers. This amplifier is designed for such service and operates with only 5W of drive to produce outputs in the order of 200W.

Simplicity is the keynote in the design and construction. It uses no silver plate, no neutralization, no bias supply, no screen supply, no grid loading, no plate loading capacitor, and suffers no damage if drive is lost. In addition, there is no necessity for protection of the tube in case plate voltage is lost since screen and plate voltages are provided from a common supply.

The amplifier derives all operating voltages from the plate supply and plate potentials may be used ranging from 750 to 1600. The most efficient operation, however, lies in the region between 1300 and 1600. Screen voltage is dropped from the plate voltage by five resistors totaling 50 kΩ. Five zener diodes stabilize the screen voltage and do not allow it to exceed 310V. Any combination of zeners may be used. The 62V 10W zeners used here were chosen because of their avail-



Grid input is at lower left, plate output at upper right. BNC connector at lower right connects to plate supply, switch on right changes screen voltage. Filament transformer on left is tapped to allow adjustment of filament voltage.



Cs	PART OF SK-600 SOCKET.
C9,C10	CENTRALAB 8585-1000.
C11	NEUTRALIZING CAP. 1-3/4 in DIA.
D1-D6	62V, 10W ZENER.
L1	2T 18 AWG TINNED 1/2 in. DIA.
L2	2T 8 AWG BARE 1-1/4 in DIA SPACED 1 in.
RFC1	30T 20 AWG ENAM 1/4 in. DIA.
RFC2	50T 20 AWG ENAM 1/4 in. DIA.
T1	12V FIL XFMR TAPPED AT 5.4, 5.7, 6.0, 6.3 & 6.6 VOLTS.

Fig. 1. Schematic of high-power rf amplifier. C_1–C_8 – 600V Disk; C_9, C_{10} – Centralab 8585-1000; C_s – part of SK-600 socket; C_{11} – neutralizing capacitor 1¾ in. diameter; D_1–D_6 – 62V 10W zener.

ability on surplus at two for a dollar (Delta Electronics, Lynn, Mass.).

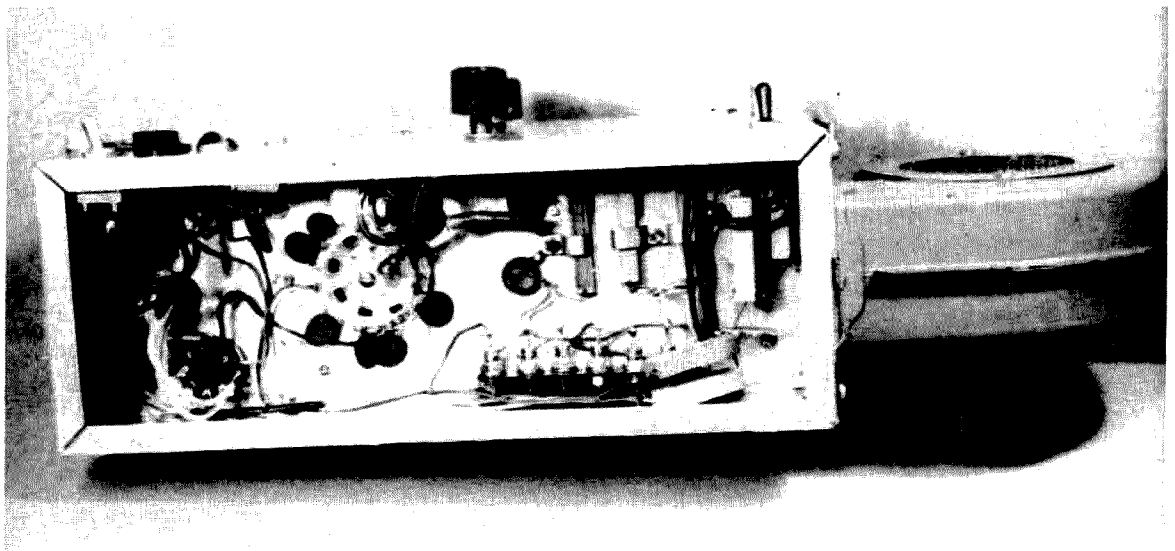
A single-pole double-throw switch changes screen voltage from 310 to 124V, allowing reduced input for tuneup or local work. Those interested in a greater range of power control may install a four-position rotary switch to tap into the zener string at each junction. All dropping resistors and zeners are located below the chassis directly in the air stream from the blower.

If zeners are not available, two VR-150 gaseous regulator tubes may be used, but the chassis will have to be made larger to accommodate the sockets.

If it is desired to monitor screen voltage and current, an octal socket is mounted behind the filament transformer. The jumper may be removed from pins 1 and 2 and a milliammeter inserted to check screen current during operation. If screen voltage readings are desired, the jumper is left in place and a voltmeter clipped to the jumper and to ground. If there is any doubt regarding the screen dissipation, it is suggested that the manufacturer's specifications be consulted.

Because of this system of deriving screen voltage, an external screen supply is not needed. The price paid for this benefit is the use of zeners and dropping resistors, but mounting them under the chassis tucks them away neatly and the blower keeps them cool.

Control grid bias is supplied by the drive in a conventional manner and protective bias is developed across a 200Ω cathode resistor shunted by another 62V 10W zener. In this manner the cathode bias protects the tube and provides a minimum voltage at all times, while the zener clamps an upper limit of 62V on the bias, allowing the tube to handle more power at high current. A zener may be used in the cathode lead without the resistors, but it



Bottom view of amplifier with cover removed. Zener regulators on copper heatsink area are at lower right, screeen dropping resistors, bias and cathode resistors at upper right located in air stream of blower for better cooling.

operates too close to maximum ratings for good design.

Manufacturers recomend a screen voltage of 250V on the screen of the 4CX250 while this dropping network places 310V on the screen instead. When calculating screen dissipation be sure to take into consideration the fact that the cathode is at 62V above ground, making the actual screen voltage 250 with respect to the cathode.

Filament voltage is provided by a 12V 5A transformer tapped on five consecutive turns. Specifications call for 6.0V on the filament of the tube and it may be desired to adjust this voltage to compensate for variations in line voltage and tube aging.

To tap into the windings, remove the shell and outer layers of insulation, exposing the heavy turns of the secondary windings. Plug the transformer primary into 115V and measure the voltage on each exposed turn by clipping an ac voltmeter to a razor blade and gently pressing it into the enamel insulation of each turn. The turns to be located are those which show a potential of 5.4, 5.7, 6.0, 6.3, and 6.6V. Most transformers are wound for three turns per volt, so these turns will lie side by side.

Tap into each of these turns with a flexible lead which will later be brought out of the transformer. Pry each turn away from the body of the transformer with the point of a small screwdriver. Cut the wire and solder a small loop of bus wire to the ends and solder the flexible lead to the terminal thus formed. Insulate the loop with a strip of cardboard before pressing back into place. A coating of corona dope or shellac completes the job.

The five new wires are brought out of the transformer to the octal socket behind the filament transformer and terminated on pins 4, 5, 6, 7, and 8. Pin 3 feeds the filament current to the tube, so a jumper from this pin to the appropriate pin provides the proper voltage to the tube. It also allows the operator to monitor the filament voltage when desired by clipping an

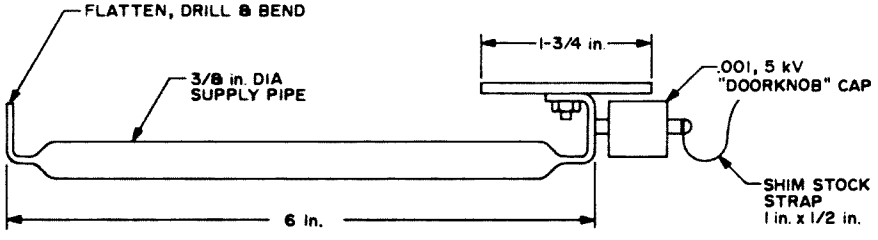
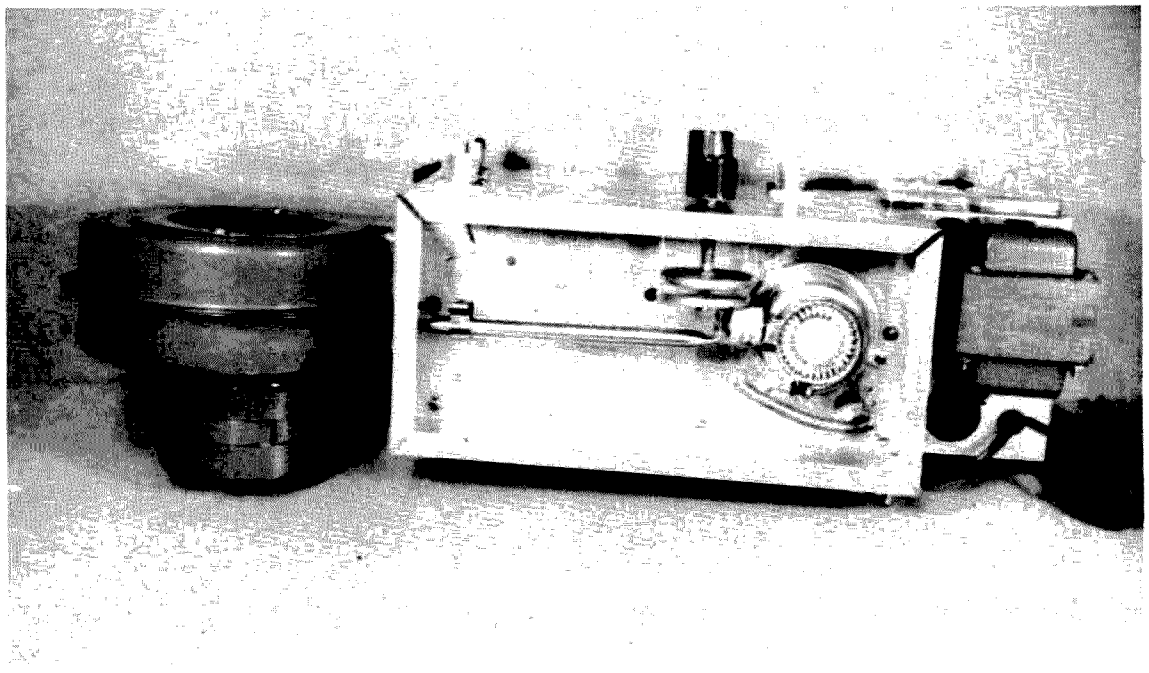


Fig. 2. Detail of plate inductor.



Top view of amplifier showing plate assembly and sliding tap on left. Tuning capacitor is neutralizing type made by National. Below filament transformer on right octal socket allows adjustment of filament voltage and metering of screen current.

ac voltmeter from ground to the jumper. Monitoring filament voltage on the 4CX250 is normally difficult due to the closed and pressurized grid compartment.

The plate circuit is quite simple and is capable of efficiencies of better than 60%. The plate inductor is formed from a length of "supply line," a chrome-plated brass tube used by plumbers, available at hardware stores for about 75¢. The ends are flattened and formed as shown into a 6 in. length. The cold end is fastened to the chassis while the other end is attached to the plate coupling capacitor and the stator of the plate tuning capacitor. The other terminal of the coupling capacitor is

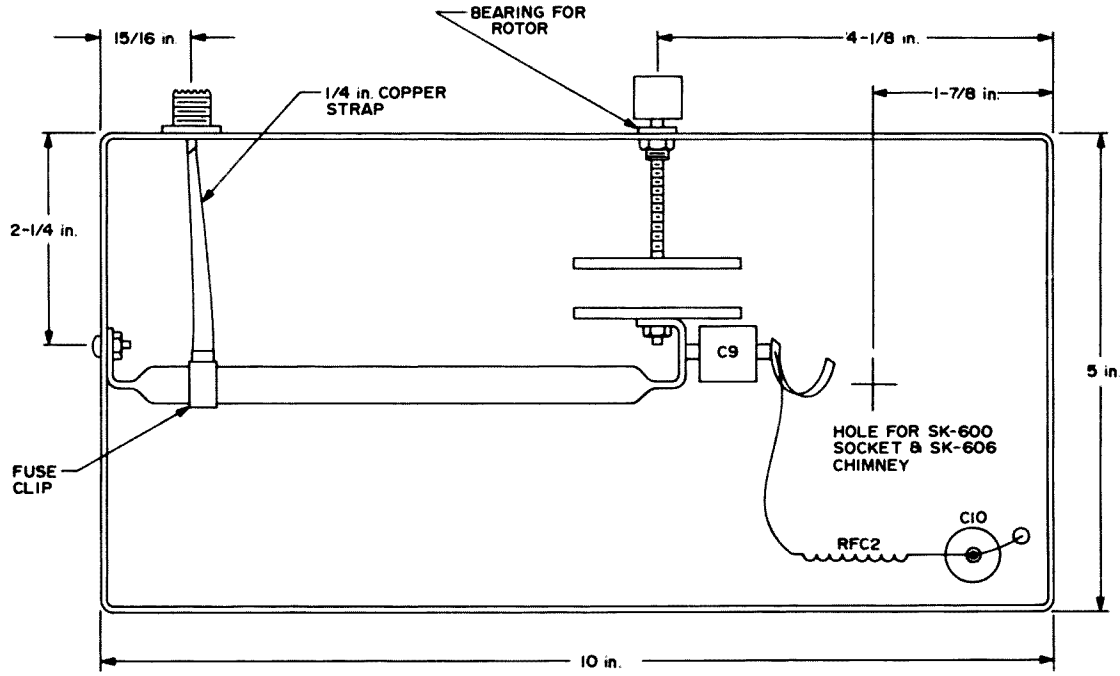
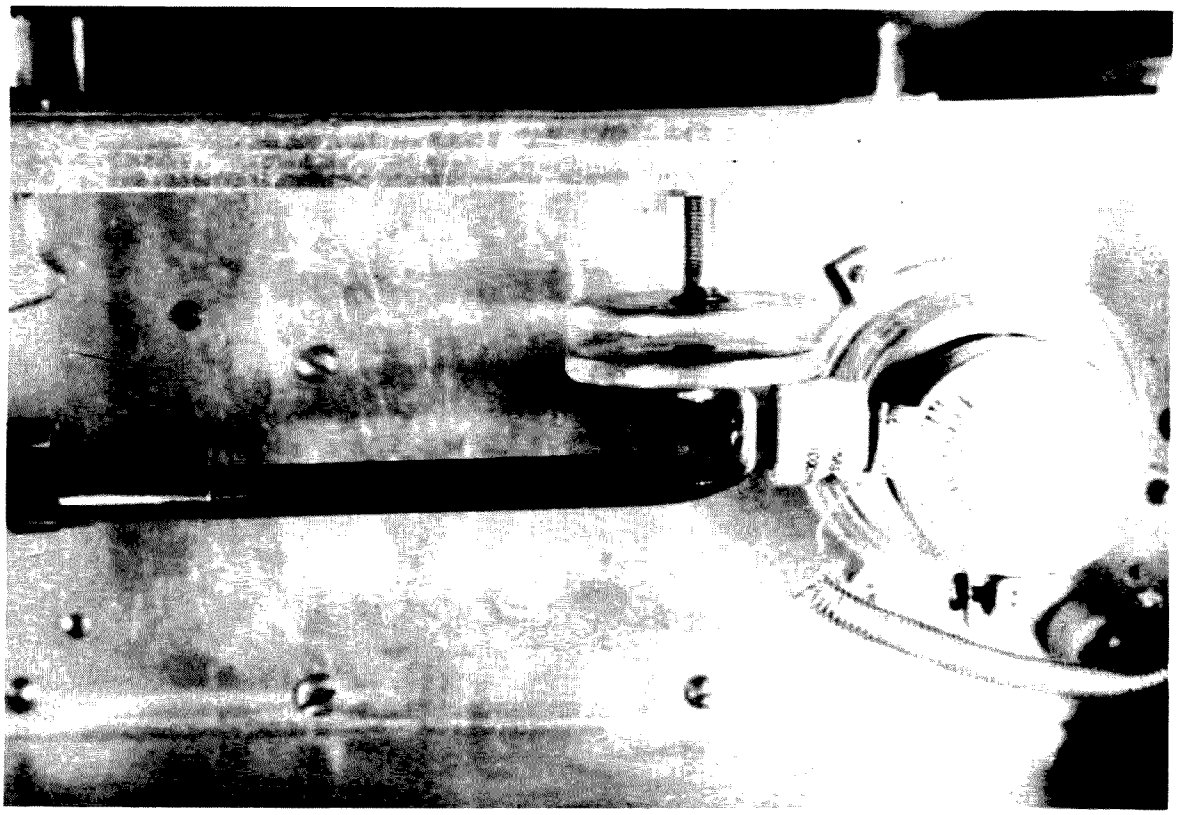


Fig. 3. Detail of chassis.



Tube and plate assembly showing coupling capacitor and bypass at lower right. Coupling capacitor is held to tube by a copper collar and short strip of brass shim stock. Plate line is a length of chrome plated supply pipe.

screwed to a small strip of shim stock which is clamped under a copper collar encircling the tube. The copper collar is held in place with a brass machine screw.

The plate tuning capacitor is made from a National neutralizing capacitor with plates 1¾ in. diameter; the movable plate is supported by the original bracket bolted to the front panel. The shaft extends through the panel far enough to accommodate a plastic knob. Place a small compression spring and a washer between the knob and the panel to spring-load the capacitor, since vibration would otherwise cause it to creep.

If a neutralizing capacitor is not available, one can be made from disks of copper or brass soldered to a 0.25 in. brass machine bolt. In this case the shaft will work into a brass or copper plate screwed to the front panel. Again, don't forget the compression spring.

The only store-bought components in the plate structure are the two high-voltage, high-frequency capacitors (Centralab 858S-1000) used for coupling and bypassing and the tube socket and chimney (Eimac SK-600 and SK-606). The chimney is necessary to force air through the plate efficiently.

The plate choke is formed of 50 turns of 20-gage tinned solid hookup wire with the insulation removed, wound around a 0.25 in. stove bolt. When the bolt is removed the turns will hold proper spacing and can be wired directly into the circuit.

The loading assembly consists of a brass fuse clip chosen to fit snugly on the plate inductor, to which is soldered a copper strip 0.25 in. wide and long enough to reach the output connector. Loading is accomplished by sliding the clip on the plate inductor.

The amplifier is constructed on two chassis, the lower one 5 x 13 x 13 and the upper 5 x 3 x 10 (Bud AC-404 and AC-422) fitted with an aluminum plate on the bottom and a perforated aluminum plate on top to permit air to escape. The two chassis are bolted together with eight brass screws and the tube socket hole cut through both at once. It will not be

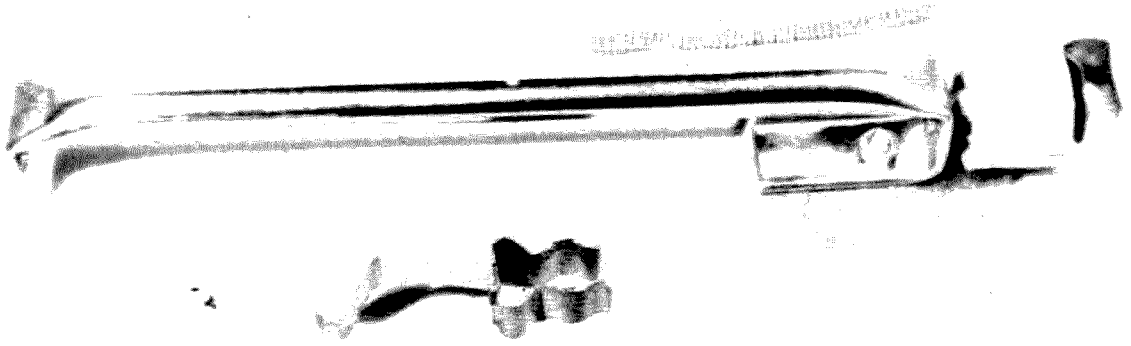


Plate assembly and stator of tuning capacitor. Plate choke is wound from 20-gage bare hookup wire. Brass fuse clip below slides on plate line to adjust loading. Quarter inch copper strap connects fuse clip to output connector.

necessary to make the grid compartment air-tight if the large blower is used. The blower provides enough air for both components and tube. In order to assure sufficient flow some small holes should be left in the lower chassis. Leave the holes open in the corners of the chassis as octal socket and at the filament transformer with putty or plastic tape.

Parts placement is not critical. Keep components in the lower compartment away from the grid coil which is supported by the tube socket on one end and the grid tuning capacitor on the other. The grid



Grid assembly of 8-gage bare copper showing tap to grid choke. Choke fastened to 10 kΩ grid leak. Mechanical rigidity is aided by fastening one end of grid coil to tube socket and other end to tuning capacitor. Zener regulators are partially visible in lower right.

plate choke, but with only 30 turns. It is necessary to use dissimilar chokes to avoid possible oscillation at the resonant frequency of the chokes. Bypassing of the cathode is accomplished by soldering in two disk capacitors at each of the four cathode terminals. It is not necessary to bypass the screen since this is done inside the socket itself.

Plate-voltage connections are made through a BNC connector. These connectors seem small and subject to arc-over but in practice operate well up to 2000V and are readily available on surplus. A jumper of RG-58/U coaxial cable equipped with male BNC connectors may be used from the amplifer to the power supply. This also provides a ground connection along with the high-voltage connection for greater safety. Even with this method, an added precaution would be to run another ground from amplifier to power supply separate from the one above.

To place the amplifier in operation put both top and bottom covers in place and energize filament and blower. Connect a wattmeter and dummy load to the output connector and a low-power 2m transceiver to the grid connector. Activate the transceiver and tune the grid to resonance indicated by a reading of 5–20 mA on the grid meter. At the same time the cathode current will indicate since the same current flows through this meter but the indication will be small.

If the drive is satisfactory, place the screen switch on "low" and apply plate voltage. Plate current will rise to about 60 mA. Tune plate for maximum indication on wattmeter. Some mechanical adjustment may be necessary between the rotor and stator of the plate capacitor. Loosen the collar around the tube and shift the position of the shim strip to place the stator in a better position relative to the rotor. Form the habit of always turning off plate voltage before removing the top cover.

If the plate tunes as it should, adjust the loading clip by inserting a tuning wand through the perforations and shifting its position until an optimum position is found which produces maximum output. Retune the plate after each change. In the amplifier pictured the optimum position was found to be 0.75 in. from the cold end.

At this point you should, with about 1600V on the plate, see about 40W on the wattmeter. Change the screen from low to high and retune the plate. It may be necessary to shift the loading clip slightly on high power. Plate current should now stand at 180 to 220 mA and output power should increase to about 200W. Turn off the amplifier and replace the dummy load with the antenna, again optimizing the tuning. The tube runs warm under these conditions and if a hand is held over the tube hot air may be felt exhausting from the tube.

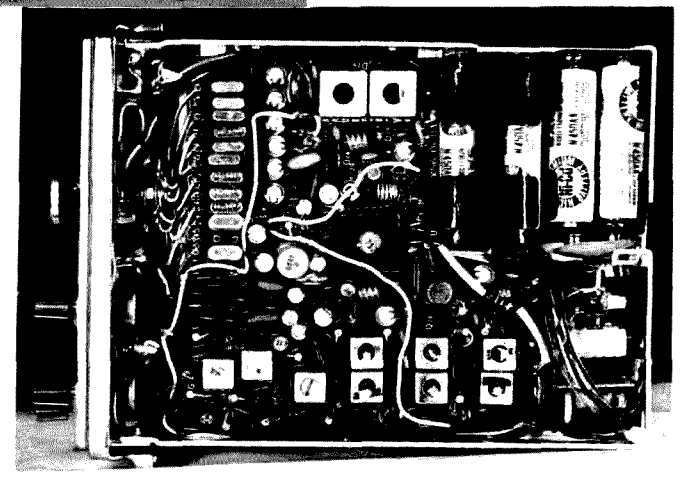
To calculate plate input and efficiency, allowances must be made for the cathode bias. If 1600V is used on the plate, the actual plate voltage will be 1540. If 200 mA is indicated on the plate meter, grid bias must be deducted. 10 mA grid current would have to be deducted from the 200 to give a plate current and screen current (combined) of 190 mA. If measured screen current of 20 mA is deducted from the 190 mA, then the actual plate current is 170 mA. Thus, the adjusted plate current must be multiplied by the adjusted plate voltage to arrive at the actual input power of the tube.

If trouble is encountered at any step, check wiring, components (even new components are sometimes defective), solder joints, and the tube. It would be wise to obtain a used 4CX250 or 4X150A for tuneup purposes. Many FM and TV transmitters retire these tubes when emission drops. It would be better to use an old one for tuneup after which a good tube can be substituted for full power. . . .W4RIZ

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Ed Webb W4FQM/1
Technical Editor
73 Magazine





DRAKE TR-22

DRAKE TR-22

Of all the FM units available to the ham today the Drake TR-22 is unquestionably the most versatile and is an exceptional buy. If you are just getting started in FM and are looking around for a really universal rig the TR-22 is the one that will work on base mobile or portable with nothing else needed other than the possible exception of a mobile or base antenna (if you're more than 25 miles from your nearest repeater). This little gem is the result of Drake getting it all together, and what a package it is, too. Here is a 6 channel unit that you can sling over your shoulder that has state of the art circuitry, a little slim hand mike with retractable cord, internal rechargeable batteries, with built in charger and an internal telescoping antenna.

Coming back from SAROC on a United flight we asked the captain if we could use the TR-22 in flight. Not only did he give us permission but he had us moved from tourist up to first class so we wouldn't be right over a wing that might mess up our radiation pattern. Having those 6 channels on the little portable unit was a real joy, for as we left Las Vegas we said our goodbyes on 94 simplex and then switched to one of the local repeater channels. We talked the repeater out a hundred miles or so and then went back to 94 for a while. As we approached Denver we started hearing their 34/94 machine so we switched over to them. After a few QSO's we went the 28/88 route for some more. Upon arriving back at Boston's Logan airport it was even possible to hit the 73 repeater on 19/79 on top of Pack Monadnock Mountain some 70 miles distant. Admittedly our repeater is 2,000 feet in the air but 70 miles is still quite a haul with a watt and a half!

Before going out to SAROC we had crystaled the TR-22 up for the trip and with the popout case of the TR-22 it was a very simple matter to change the crystals around as they are all on top of the board right out in the open. Strapping is very easy, too, as each crystal has a terminal post right by it and jumpers go right in where they are needed The transmitter warp trimmer capa-

citors are right by the transmit crystals and the receiver does not need any warp capacitors. Changing crystals is very easy because to get the TR-22 out of the case you don't even need a screwdriver. All you do is pull out the two little snap releases on the bottom of the case and the unit slides right out.

Using the TR-22 mobile is a snap as you only have to plug in the external dc power cord (so you save your ni-cads for portable operation) and plug in your mobile antenna. The little unit is so small that you can easily slip it into the glove compartment. Thus the chance of theft is greatly reduced. It takes only seconds to unplug the dc power cord and mobile antenna so you can take it with you if you don't want to leave it in the car. At this point you just pull up the internal telescoping quarter wave whip and you are working as a portable.

It is interesting to note that the TR-22 comes with a complete set of ni-cad batteries as part of the unit – not another accessory that you have to purchase. The same is true for the built in battery charger – it's all inside the unit with nothing else to buy. When you are at home just plug in the ac line cord and the batteries get recharged overnight. If you want to monitor at home or work the boys a little bit, the battery charger gives just enough current to operate the receiver so it doesn't pull your ni-cads down. Of course when you are listening with the ac plugged in, the ni-cads do not get charged until you cut the power switch off. If you transmit while you're at home then that additional current comes out of your ni-cad batteries. To check the condition of the batteries just turn the squelch control all the way counterclockwise and the S/ rf output meter gives you a battery voltage reading. This same little meter automatically works like an "S" meter on receive, so you can find a 'hot spot' if you're having trouble getting into the repeater. On transmit the little meter gives you a relative rf output indication so you know that you are getting out and also gives you some indication of how your batteries are doing under a heavy load. When your output power starts to fall off too much, a quick battery check will reveal that the batteries need a charge. The ac power cord or any of the external power or antenna cords can be plugged right into the bottom of the TR-22, even when it is in its carrying case.

The Drake TR-22 is a very rugged trouble-free unit. Recently when the 73 repeater (19/79) pooped out up on top of Pack Monadnock and there was quite a bit of snow on the access road, we slung the little TR-22 over our shoulder before mounting the snowmobile in zero degree weather. While going up the mountain we got a little carried away and hit an ice ridge and a big wipe-out occurred. After sailing off the snowmobile I landed spread-eagled right on top of the TR-22! Picked myself up and checked back in with K1NUN with no problem at all. After finally getting up on top of the mountain we worked in unheated buildings for a couple of hours and all the while using the little rig. With this kind of use that our TR-22 gets, it has got to built like the proverbial brick house. The TR-22 has proved so reliable that Drake has had very little warranty work to do and as a result has held the $195 price even though the U.S. dollar has been devalued by almost 20% in Japan.

Drake rates the TR-22 transmitter at 1 watt (conservative) but we keep measuring 1.5 to 1.6 on the Bird Termline in our lab. The receiver is rated at less than 0.5 μV but actual testing shows very near 0.3 μV. The receiver is double conversion with an FET rf stage and a ceramic filter in the 455 kHz stage. The first i-f frequency is the standard 10.7 MHz. IC's are used for the second i-f limiter and also for the af output. The TR-22 utilizes all solid state switching (no relays) for maximum reliability. The instruction manual for the TR-22 is very complete and easy to understand. It contains all of the operating instructions, labeled schematics with voltage charts for all transistors and IC's, complete pc board pictorials that are also labeled, and complete crystal data.

The Drake TR-22 is a fantastic little piece of gear and one of the most versatile units we have ever seen with so many normally optional features built in as standard features. Its performance is as amazing as its low price. It is truly a universal rig.

. . .W4FQM/1

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Brooklyn NY 11227

AN AUTO-BANDWIDTH SELECTOR UNIT

This experimental unit attempts to set the bandwidth of a receiver automatically in accordance with QRM conditions. Although described as an outboard unit, the circuit switching arrangements described can also be wired internally in many receivers.

Many commercial receivers and even some transceivers have provisions for the independent switch selection of various i-f bandwidths for reception purposes regardless of the transmission mode (AM, CW, SSB, etc.) switch setting. Generally, most operators like to use a wide bandwidth when a band is not crowded, because of the tuning ease involved, and then switch to a narrower bandwidth as QRM conditions develop. It would be very handy, however, to have the receiver automatically switch to an i-f bandwidth appropriate to the QRM conditions. Such operation would be particularly desirable, for instance, when one is working a station and using a wide bandwidth and then suddenly a strong QRM signal appears. Usually, before one can readjust the receiver, some portion of the transmission will be lost.

This article describes an outboard receiver accessory unit which was developed to provide automatic bandwidth selection. The unit is complete in itself and makes an ideal accessory unit that can be added to a receiver or transceiver that does not have selectable i-f bandwidths. In the case of units which already do have selectable i-f bandwidths, the switching circuits used can be adapted in most cases to work with the installed i-f filters. The unit provides for two automatically selected bandwidths (which can be chosen for either phone or CW service), although the basic scheme can be expanded to include a greater number of bandwidth positions. A manual override switch is provided for manual selection of either bandwidth position.

Basic Operation

Figure 1 shows a block diagram of the basic stages involved in the selector unit. The filter stage is placed between the i-f stages in a receiver. It is controlled, through the other stages shown, by the level of the i-f signal preceding the filter stage. The amplifier stage boosts the i-f pickoff signal and then the output of this stage is rectified to provide a dc control voltage. The dc control voltage in turn operates a Schmitt trigger stage which operates a diode switch for bandwidth selection. The i-f pickoff is taken after the first i-f stage and not directly after the last mixer stage, so the unit will not respond to signals greatly outside of the normal i-f bandpass. The pickoff could be taken after the filter stage, but this will not provide as sensitive a response with receivers having good avc/agc action, since signals passing through the

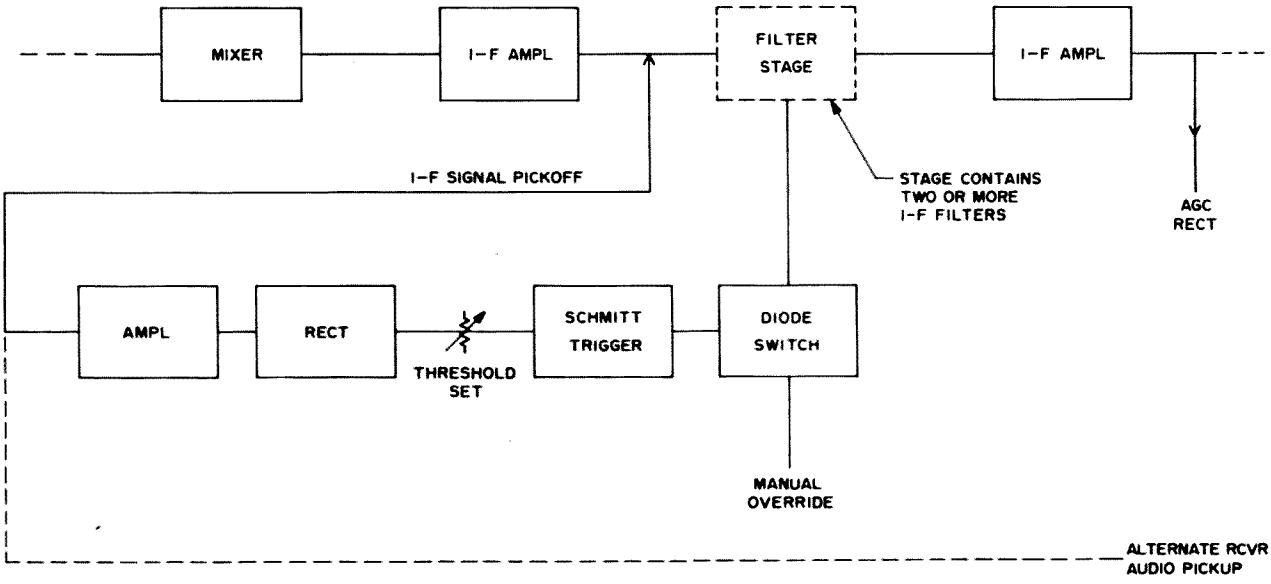


Fig. 1. Basic block diagram of the auto-bandwidth unit. Filter stage is inserted between i-f stages in a receiver. Diode switch as activated by level of i-f signal causes different i-f filters to be used.

filter stage will control agc action. However, the unit can be used in this manner and the control pickup signal can even be the audio output signal.

The unit operates simply on the basis that any i-f signal of sufficient amplitude which exceeds a preset threshold value will cause the diode switch to be activated and switch in the narrower of the filters in the filter stage. One can devise more elaborate triggering schemes where a stage samples and integrates the signal levels in the i-f passband to determine when the QRM level has reached a level requiring a narrower i-f filter, but the circuit complexity involved produces little in the way of better performance. Some provision has to be made so the unit will not be activated by extremely short, high-energy signals appearing in the i-f bandpass – such as a noise pulse – and yet not immediately reset the filter stage to a broader bandwidth after an energizing signal has set it to a narrow bandwidth. If the latter is not done, the unit would tend to follow a high-level CW QRM signal and keep switching the filter stage in accordance with the keying. The necessary discrimination against single pulses and the necessary time delay in filter switching is accomplished by a careful choice of the components in the rectifier stage and by the action of the Schmitt trigger stage. It is in the selection of these components and the action of the Schmitt trigger stage which mainly makes the unit described different from a simple VOX unit where such a unit is activated by receiver instead of transmitter audio and the VOX relay controls the selection of two different i-f filters. However, one can, by experimenting with the circuit time constants, adapt many VOX units for use as receiver audio-activated automatic i-f bandwidth selectors.

Practical Circuit

Figure 2 shows the actual circuit of the selector unit. Discrete transistor stages could be utilized but the use of the readily available and inexpensive Fairchild μL 914s simplifies the circuitry and is actually less expensive than using all discrete components. The first μL 914 unit serves as an amplifier stage and has a frequency response that extends from the low audio frequencies to about 1 MHz. The stage, therefore, does not have to be modified whether the pickoff point to trigger the selector unit is taken at some point in the i-f chain of a receiver or at the audio output of the receiver.

The second μL 914 units is wired as a Schmitt trigger. Normally, the output (terminal 6) of this stage is at nearly ground potential. When about 1.5V input is applied (terminal 1), the output rises to almost the supply voltage potential (+4.5V). The output remains at this level until the input voltage drops to around 1.1V, at which time

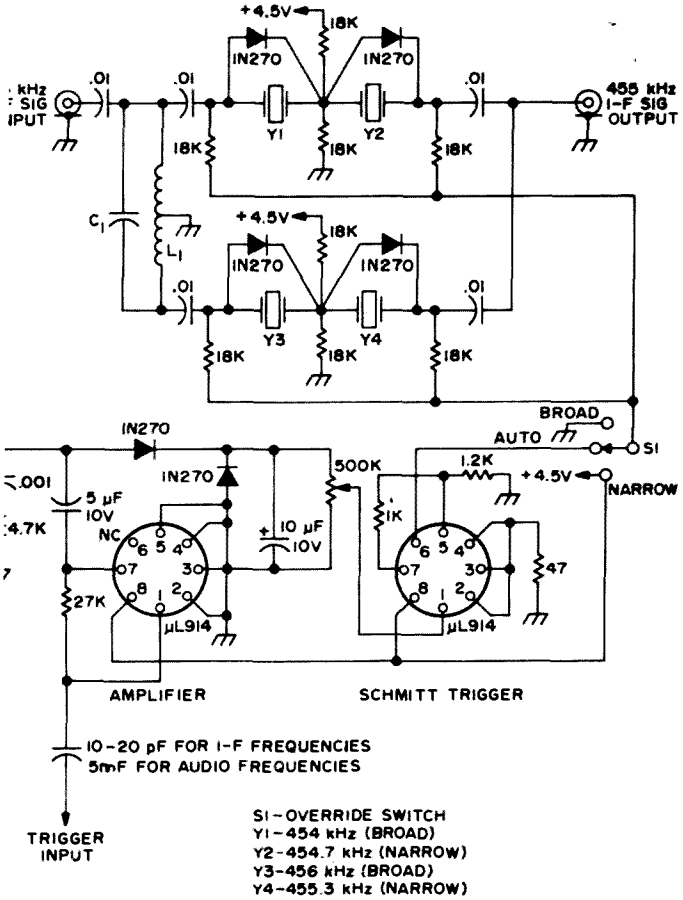


Fig. 2. Circuit diagram of the auto-bandwidth unit. The trigger input can be af or an i-f frequency up to about 1 MHz. C_1 L_1 are chosen to resonate at the i-f frequency being used. Crystal frequency spacing is chosen on basis of bandwidth desired.

the output again returns to about ground potential. This "hold" action on the part of the Schmitt trigger, plus the characteristics of the rectifier circuit between the two µL 914 units gives the unit the delay characteristics previously described as necessary. The output of the Schmitt trigger drives a diode switch arrangement across a crystal filter circuit. Although the diode arrangement tends to make the circuit look somewhat confusing, the crystal filter circuit is a completely standard two-crystal circuit. The circuit is centered on an i-f of 455 kHz. The 454 kHz and 456 kHz crystals provide a bandwidth of about 2 kHz, while the 454.7 and 455.3 kHz crystals provide a bandwidth of about 600 Hz. Any other bandwidth can be chosen by proper spacing of the crystal frequencies, as well as any other i-f by choosing L and C to resonate at the i-f. When the output of the Schmitt trigger is at ground potential, the diodes across the 454.7 and 455.3 kHz crystals are forward-biased, and these crystals are effectively short-circuited. The diodes across the "broad" bandwidth crystals are back-biased and these crystals control the i-f bandwidth.

When the Schmitt trigger is active, the opposite condition takes place. The output of the trigger stage causes the diodes across the "broad" bandwidth crystals to be forward-biased and those across the "narrow" bandwidth crystals to be back-biased. The switching action is very fast and noiseless. Assuming that an existing i-f strip has sufficient reserve gain to compensate for the loss in the crystal filter circuit, as most receiver i-f strips will, the circuit of Fig. 2 can be used to build an outboard accessory unit for use with almost any receiver or transceiver. In those cases where a receiver already has built in several i-f filters which it is desired to utilize, the circuit of Fig. 2 can still be used and the diode switching arrangement shown applied to the built-in filters.

If the diode switching scheme is not easily adapted to the filters, the µL 914 Schmitt trigger stage can be used to drive a switching transistor which in turn activates a relay to switch the i-f filters, as shown in Fig. 3. The basic scheme shown can be expanded to several more stages of progressive selectivity by using more Schmitt trigger stages, each with a separate threshold control to trigger in turn as the output level of the first µL 914 amplifier stage increases.

Construction and Adjustment

The unit can be assembled either as an outboard accessory unit, or internally in a

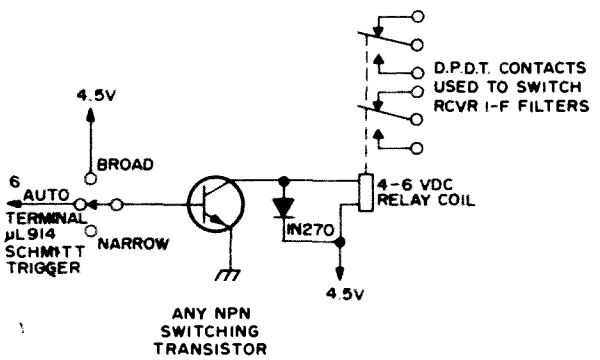
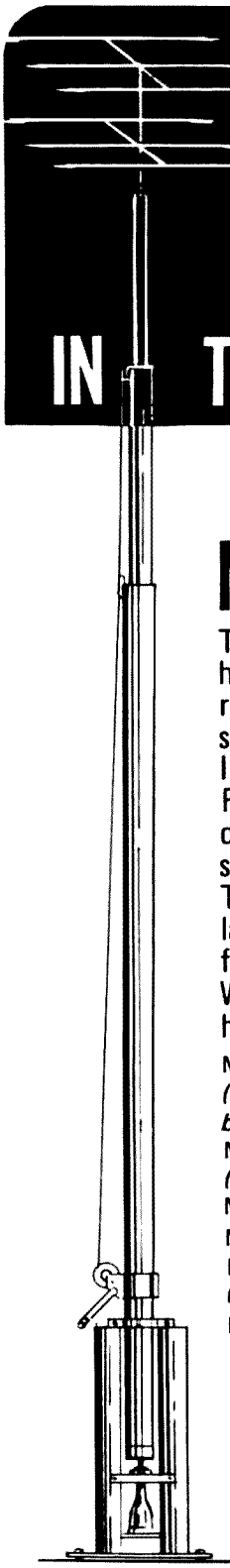


Fig. 3. Instead of using diode switching and an external crystal filter, the two µL 914 stages of Fig. 2 can be used to control a relay for switching the interal i-f filters in a receiver.



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receiver. The latter type of placement is most convenient when utilizing the i-f filters built into a receiver. There is nothing critical about the construction of the unit except the usual precautions of lead dress, etc., appropriate to the i-f being used. The threshold control has to be available as a panel control since it requires manual adjustment depending upon band conditions and depending upon the setting of the rf and/or i-f gain controls in a receiver (also depending upon the af gain control setting if the receiver audio output is used to trigger the unit). With some practice, the threshold control can be set so that the unit is activated when the QRM level just exceeds that of a signal being copied.

Results

Several experiments were tried using the unit of Fig. 2 for CW reception with a 455 kHz i-f receiver. Triggering the unit from the first i-f stage output in the manner shown in Fig. 1 produced the best results. However, audio triggering was also quite effective as long as the agc circuit in the receiver was disabled. The main value of the unit was in moderate to heavy QRM situations, where very strong signals were apt to suddenly appear while a relatively weak station was being copied.

The use of the unit did not completely guarantee continued reception of the weaker signal because of other factors being involved such as receiver overload, agc capture, etc. However, the unit reacted to the QRM situation almost instantaneously as compared to the time required to manually readjust the i-f selectivity. Some further refinement of the unit is certainly indicated. The constant readjustment of the threshold control might be eliminated by linking the "base" level for this control with the level on the bias line in the receiver as controlled by the rf gain control. Nonetheless, the unit did demonstrate the real advantage of an auto-bandwidth feature for use in receivers under today's heavy and suddenly changing QRM conditions. With some added refinements, such a unit should prove to be as useful as such accepted receiver features as avc/agc, automatic noise limiters, etc.

. . .W2EEY

Eric Falkof K1NUN/1
Assistant Editor
73 Magazine

"Break"

". . . so I told him where to get off the expressway and I guess he's all right now, Steve. Well, it's getting late, about 11:30, so I guess I'll knock off and go to bed. Been good talkin' to you. WB1ABC, this is W1XYZ." ssshhhkchunk

"Right, Bill. That guy'll be OK as long as he doesn't go too fast. It's a bit slippery out there and driving is kind of poor. I got in only a little while ago and it seemed like it was going to get colder and freeze up all of this snow that's lying all over the place. When you come right down to it, it's really not too good out there at all, but as I say, if he takes it easy, he'll be OK. Say, before you go, can you tell me what's going to happen at the meeting Friday? Break." shshshk "Break"shshkchunk

"OK, stand by, breaker. Steve, the meeting is going to be held at Les's house instead of at Mike and Laura's like it was planned. Seems like their little daughter caught the flu. We're gonna see a slide show about the new repeater down in, oh, what's the name of that city in Rhode Island? You know what I mean, Steve? Break." shshshsk "Break"shshsshkchunk

"Breaker stand by please. Yeah, it's in the Bay area. I forget the city you mean, but I know what you're talking about. Go." shsh"Br –

"Right. Didn't want to let the tail drop. No sense wearing out the relay. Well, the pictures will be about that new machine they're setting up. It should be a good one. Say, I'm bringing my wife. Why don't you bring yours? All the gals can head off to the kitchen while we take in the show. They never want to see any of this radio stuff. What say?" shshs"Break"shshskchunk

"OK. Just a minute, breaker. Good idea, Bill. I'll let her know what's happening. I know she'll want to see the others. Hey, here's an idea. Why not have all the wives

bring a little home brew something. Since Les and the missus are being caught by surprise, we all can help out with the goodies." shshsshsh –

"That's a good one. I'll tell the little woman." shshsh –

"First thing tomorrow morning I'll get in touch with Joe and Mel and have them each call a few of the guys and we can get the wives working on this right off. We can make a real party out of this. I'll even volunteer to leave for a while and get some pizza if anyone wants some. If we get ahold of the Sokittoommee VHFers, we could make a hamfest out of this." shshsh"Break"shshsh skchunk

"Yeah, and what about this kids?" shshs –

"No problem. The high school is on vacation now so there should be a lot of baby-sitters available. Even on short notice. It's a natural. shshshshkchunk

"All right then. It's settled. I'll call up the host and hostess. Boy! Will they be surprised. It's a good thing they have a large house. Some coincidence, eh?" shshs –

"This is great. But what about the weather? It looks like it might start coming down and the weatherman says there's a pretty good chance of more of the white stuff and some icing over." shshsh –

"Well, there are a few hardy souls with four wheel drive cars. If it's not too bad, they might be willing to make the rounds and pick everyone up. There are only ten of our guys and six of the 'toommees and everyone is pretty close together anyhow." shshshskchunk

"I dunno. It could be pretty slippery, even for a four wheel drive. I'm not so sure any more that it's a good idea. Like, the slides will be good. That's a fact, but if it's snowing, the high schoolers won't be able to get out for the most part and most of us are parents and won't go out ourselves either. on a rotten night, it seems like that's the only time a family gets together. If it were really bad, I'd like to stay in with my family. Wait a minute . . . I'm listening to a weather report . . . high winds . . . slippery driving . . . rain, later turning to snow and sleet . . . low fog . . . Wow, it sounds pretty rotten right now. I wonder about tomorrow, Bill." shshsh"Break"shshkchunk

"Hang on, breaker. Y'know, Steve, maybe it was a lousy idea after all." shshs –

"No, Bill. It's just that the weather is so poor and driving is unpredictable. That's all. It's a good idea. It's just that the timing is off. Maybe for the next meeting we can all get together. Hey, I just got another idea. How about the two clubs setting up a joint repeater. Whadoyou think of that?" shshshkchunk

"I like that idea. What with two sets of brains in this town, we should get together to do something like that. I've been foying with the idea of putting one up myself." shshs –

"No. Go on, you couldn't do it and you know it." shsh –

"Really. I've even collected all the parts for one. I just gotta lash them all together." shshsh –

"You're fooling." shshsh –

"It's true. You can come over any time and see it all." shshshs –

"I still don't believe you." shshshkchunk

"Well, the proof is in the pudding. Speaking of pudding, that's what it looks like out there right now, and that's what I'll look like inside if I don't get some sleep. Say, whatever happened to that breaker. C'mon ahead breaker." shshshskchunk

"Yeah, c'mon ahead breaker." shshshskchunk

"Breaker, speak now or forever hold your peace." shshshkchunk

"One last chance." shshshshkchunk

"Steve, you don't suppose there was an accident, do you" shshshshshkchunk

"No, I doubt it. The guy sounded OK when he spoke. I don't think anything is wrong." shshshshkchunk

"But he tried to break in so many times" shshsh –

"Look. He would have said something if something was wrong. Wouldn't he have?" shshshkchunk

"Yeah. I guess you're right. Well, see you at the meeting." shshshshskchunk

"Right. This is W1XYZ clearing with WB1ABC at twelve-thirty on a mucky night. G'night." shshsh –

"G'night." shshshshskchunk

K1NUN/1

Ed Webb W4FQM/1
Technical Editor
73 Magazine

THE CASE FOR TONE ACCESS

Tone access is the best way to protect repeater inputs when two or more repeaters share a common input frequency. In many cases the coverage of the repeaters overlap each other and a mobile trying to access one may bring up several others too. This situation is highly undesirable as well as annoying to the monitors of the other repeaters, particularly if they have automatic logging. Tone access can be effective in eliminating these unwanted key ups and is used in three different modes: Continuous Tone Coded Squelch (CTCS), Tone Burst, and the "Whistle-Up."

Of all the tone access systems CTCS is the most positive as it will even work when the input signal to the receiver is quite noisy. In a CTCS system a small encoder is mounted in the mobile of base transmitter and supplies a subaudible tone in the range of 80 to 180 Hz to the audio input of the transmitter. Each time the CTCS equipped are placed on the air the CTCS tone is continuously transmitted at a level that is about 20% of the maximum speech deviation. In a typical narrowband system where the maximum speech deviation is ±5 kHz the CTCS deviation level is adjusted between ±750 Hz to 1 kHz. The repeater input receiver in turn is fitted with a CTCS decoder and this is used to control the repeater transmitter in place of the usual Carrier Operated Relay (COR). Thus the repeater can only be brought up by an input signal having the proper CTCS tone frequency, and when this signal goes off the air the repeater will drop out even though there is another signal on its input frequency. It is the CTCS tone that not only brings the repeater up but also holds it up and when there is no CTCS tone the decoder cuts the keying voltage off to the transmitter. (Of course there is normally a few seconds drop out time but the repeater does drop as this type of control is very positive. A CTCS system is fairly secure as the decoder will only respond to CTCS signals that are within ±1 Hz of the CTCS decoder frequency.) CTCS is widely used in Motorola calls their system "Private Line" or P.L., and General Electric calls theirs "ChannelGuard" or C.G. For those amateurs having commercial rigs the installation of a CTCS encoder is only a matter of wiring up the manufacturer's encoder in the unit. But for the ham who has an imported unit or a piece of older commercial gear the installation of a CTCS encoder has posed somewhat of a problem. But recently some small CTCS encoders have become available in the price range of $15–$25. These types of encoders use resonant reeds as the frequency determining device and you can figure on spending an additional $18.50 for the required reed.

Avcom[1] has also come out with a new small CTCS encoder that is quite different than the rest in the fact that it does not use a reed but a low frequency crystal instead. The crystal gives as good as or better than the necessary ±1 Hz stability and its cost is less than one third of the cost of the reed. Avcom calls their little CTCS encoder a PL100 and it is all solid state using both transistors and digital IC's. Its dimensions are 1.5 x 6.2 x 4.4 cm (0.6 x 2.4 x 1.75 in. [H x W x D]). The PL100 utilizes a crystal controlled multivibrator whose output is fed to three IC decade dividers to obtain the desired CTCS tone frequency. The output of the last decade divider is fed to a two section low pass filter to obtain a sine output. Suppose you want a CTCS frequency of 110.9 Hz (a standard CTCS channel frequency) – you would simply use a 1109 kHz crystal since the encoder divides its frequency by 1000. The PL100 also has a built-in voltage regulator since the logic requires 5 volts. The encoder will operate over 11 to 15V dc input and has adjustable high and low impedance outputs. The crystals for the PL100 are available from JAN Crystals[2] at $4 (per crystal) for 100 Hz and $6 for the proper crystal for any other CTCS tone. The Avcom PL100 is available in three forms: a PC board, parts list, schematic and pictorial for $6; a complete kit for $17.95; and the completely assembled unit for $24.95. All three forms require the addition of a crystal that is the desired CTCS tone frequency times 1000.

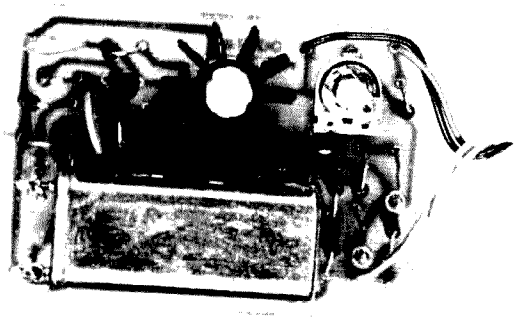


Fig. 1. Avcom PL-100 CTCS encoder

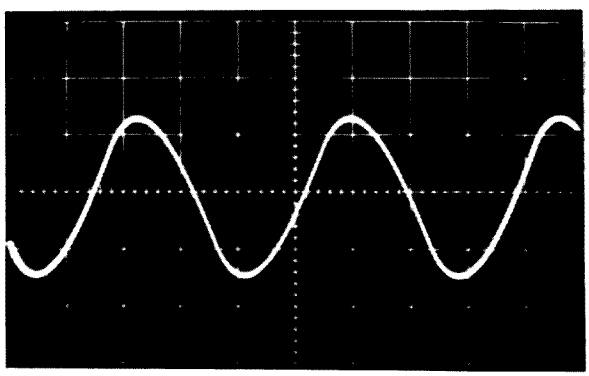


Fig. 2. Output waveform of Avcom PL100.

Tone burst access is the second form of tone access systems and is the simplest way to go as the frequency tolerances are not as critical as those of the CTCS system. Tone burst also allows a multichannel or multitone encoder that can be used on many repeater systems. A tone burst encoder is simply an audio oscillator whose output duration is controlled by a timing circuit. The timing circuit can be triggered by the grounding of the transmitter push-to-talk (PTT) lead or by the application of +12V dc to the encoder. Most tone burst encoders use the PTT type of keying that grounds a lead from the encoder when the mike button is pushed. Normally the tone burst duration is set at 500 ms. Some tone burst encoders have as many as six tone frequencies which is more than adequate. This allows the user to access a number of repeaters that have common input-output frequencies but different tone burst frequencies. The tone burst begins as soon as the operator pushes his mike button and lasts for a half second. This happens automatically each time the operator begins a transmission. However the operator must now remember to pause for a half second before beginning to talk thus giving the tone burst time to complete. If the operator were to speak during the tone burst the speech would interfere with the tone and the decoder at the repeater may be confused at the complex wave form and the repeater may not come up. The tone burst deviation is normally set to be 60% of the maximum speech deviation. A tone burst access repeater requires a tone burst decoder at the receiver site in addition to the COR. Both must give positive outputs before the repeater will come up on the air. The tone

[1] Avcom, P.O. Box 29153, Columbus OH 43229.

[2] JAN Crystals, 2400 Crystal Drive, Fort Myers FL 33901.

burst access system has one minor drawback – if there is another signal present at the repeater input after the initial tone up station goes off the air, the repeater will stay up until the three minute time-out time drops it out. Normally the tone burst decoder is reset by the COR dropping or by the time out timer activating. The tone burst decoder also resets the time out timer each time a tone burst is received.

Most tone burst encoders use an LC type of audio oscillator that has excellent frequency stability but requires precision capacitors or padding capacitors to set the oscillator exactly one frequency. Other tone burst encoders use RC oscillators, integrator oscillators, and Voltage Controlled Oscillators (VCO). All of these last three types have an advantage that the tone frequency may be set by the use of pots thus allowing the user to have a number of pots and a selector switch to select various tone frequencies. Each pot can adjust the oscillator over a range of about 1400–2600 Hz. These types of encoders are easily set to frequency by the use of a frequency counter and a screwdriver, and shorting the burst timing capacitor.

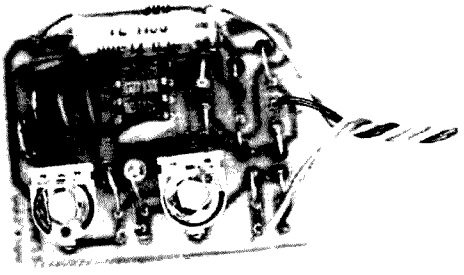


Fig. 3. Avcom TN421 tone burst encoder

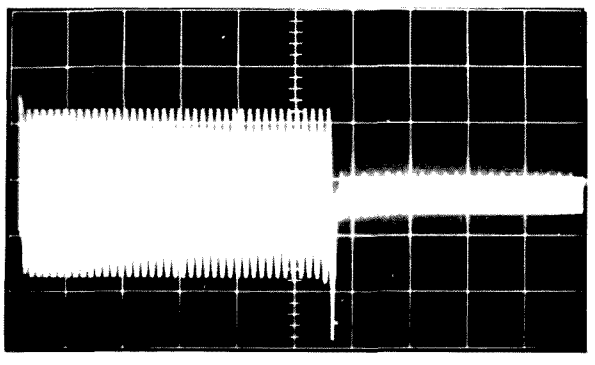


Fig. 4. Burst envelope of Avcom TN421. Horiz. = 100 MS/cm. Note: Extra ripple was due to stray ac pickup in test gear.

The Avcom TN421 is an integrator oscillator type of tone burst encoder using only one IC and an RC burst timing network. It is so small that it can be mounted in the Drake TR-22 with ease. The TN421 is only 1.5 x 4.5 x 3.8 cm (0.6 x 1.8 x 1.5 in. [H x W x D]). It only requires the connection of three wires to hook to a transceiver: +12V dc, audio to the mike input, and a wire to the PTT connection. The TN421 has a frequency range of 1400–2600 Hz and has adjustable high and low impedance outputs provided. It has a nominal 600 ms tone burst. The TN421 is available from Avcom all built and ready to go for only $19.95. It will also fit in a commercial rig control head.

The third type of tone access system is the whistle-up which is a form of the tone burst except that the frequencies used are between 1500 and 1800 Hz. The decoders are about 100 Hz wide as are the ones for the normal tone burst frequencies. Due to the lower frequencies the average ham can whistle the proper tone and bring up the repeater. There are many different types of CTCS and tone burst decoders. Most commercial and ham decoders use resonant reeds for the CTCS and LC circuits for the tone burst frequencies.

A new type of tone decoder is appearing on the horizon in the form of a Phase Locked Loop tone decoder. One such device is the Signetic NE-567 and will work with a –6 dB signal plus noise-to-noise ratio. This gives very impressive performance. Its tone decoding frequency may be set by use of a pot and a frequency counter. There is no input signal required to adjust the NE-567 as all that is necessary to do is to monitor the VCO frequency with a counter to set the decode frequency. The bandwidth may be set from a few hundred Hz to about 10 Hz depending on your needs. It has a frequency range from a few Hz to several hundred kHz.

So if your carrier access repeater is being bothered with unwanted key ups from other systems and/or if you are being bothered with intermod or stray signals, tone access is the answer. The equipment is available now so you *can* do something about it rather than gripe about it. It's not complicated nor expensive and it is a solution that works.

. . .W4FQM/1

Forrest D. Thomas K9MRL
3335 Central Ave.
Columbus IN 47201

CUSTOMIZED AFSK-MCW & CODE PRACTICE OSCILLATOR

The complete AFSK-MCW, and code practice oscillator using an IC circuit is built into a standard 4x2¼x2¼ in. minibox. A printed circuit board is used, and careful placement of parts is necessary in order to get all the parts into the box.

Obtain one jack and a plug like the one on the transmitter to be used. Mount the jack on one end of the box, and bring the plug out the other end using shielded cable. Mount all components in the box. It would be a good idea to tune the coil and check its operation first. So, with the switch in one position, normal mike control can be used. With the switch in the other position you can key the transmitter, and insert AFSK-, or MCW at the mike input, and at the same time cut off the speaker. Any combination of switching arrangements can be used to suit your particular needs. Even a small relay could be used.

To use as a code practice oscillator, no connections to the transmitter are necessary. Plug a speaker into the speaker jack (voice coil is not critical). Plug a key into the key jack. You can use either the 2125 Hz tone, or break the connection at the keyboard connection, and use the 2975 Hz tone.

Sw#1 is a 3 pole double throw switch to fit your need, and Sw2 is part of the mike control system.

Parts other than C1, C2, and C3 are not critical. These should be mylar capacitors. Do not use ceramic or disc capacitors since these tend to cause drift.

Tuning of L1 can be done by varying the capacity of C1 and C3, or taking turns off of L1. For best results you should be very close to frequency. With the keyboard jack closed you should have a 2125 Hz tone; with it open you should have a 2975 Hz tone. In some cases a polar relay, a high speed relay, may be necessary across the printer contacts to key the oscillator.

. . .K9MRL

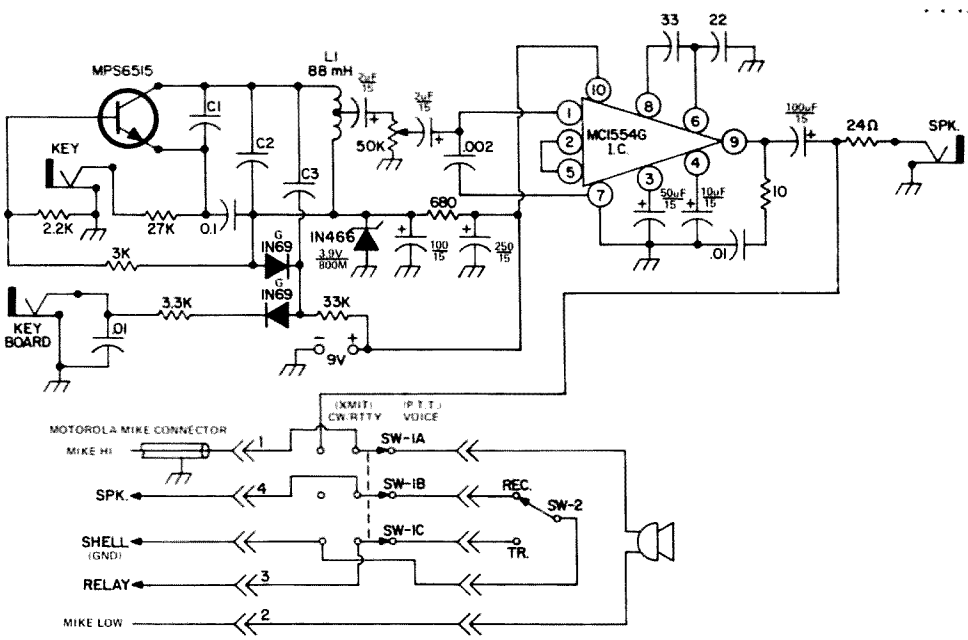


Fig. 1. Integrated circuit AFSK-MCW or code practice oscillator.

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Deerfield Beach FL 33441

USING THE LM 373

About 2 years ago a new integrated circuit was announced by National Semiconductor and was labeled the LM373. Inside the little TO5 can were the makings of 4 gain stages, an agc section, a balanced mixer and a peak detector. At least that's what the poop sheet said, and circuits were shown for using the little jewel in various types of i-f strips. I was fortunate at that time to acquire an LM373 and promptly breadboarded an SSB i-f strip to see how it would perform. It performed amazingly well and I was sufficiently impressed to start planning a receiver designed around this new IC.

Although I didn't know it at the time, all the ingredients for a classic demonstration of Edsel Murphy's Law were gathering for the final curtain. The clincher came when word got around that the manufacturer had thrown in the towel. That's when Murphy struck and left me with a crisply burned collector's item.

Now, 2 years later, I once again own an LM373 and have been assured by the company rep that these items are here for keeps and are available from distributors.

The present LM373 is basically the same as its predecessor, including pin connections, although internal circuitry is somewhat changed. The device will perform many diverse functions which make it adaptable to AM, FM, or SSB i-f systems by merely changing a few connections. In the application described here, the IC is used in a receiver capable of operating in either AM or SSB modes. It was made small only because my hangup is miniaturization. It is designed to cover 3.5 to 4.0 MHz and an all-band converter will someday be used ahead of this "tuneable" i-f. If the cabinet had been about an inch larger, I might have gone all the way right from the beginning.

Let's take a look at this new device and see how it may be used to perform the functions of particular interest to the ham. Figure 1 shows how the various sections of the circuitry are tied together internally and which points are brought out to pin connections. Note that the IC is divided into 2 separate areas having no common internal signal path. The upper portion, consisting of 2 gain stages and the agc section, is externally coupled to the remaining circuitry by the main selectivity determining device. This usually consists of a mechanical, ceramic, crystal or LC filter operating in the 50 kHz to 15 MHz frequency range.

In order to better understand just how the various sections of the LM373 can be made to perform the desired functions, let's look at some block diagrams. Figure 2 shows

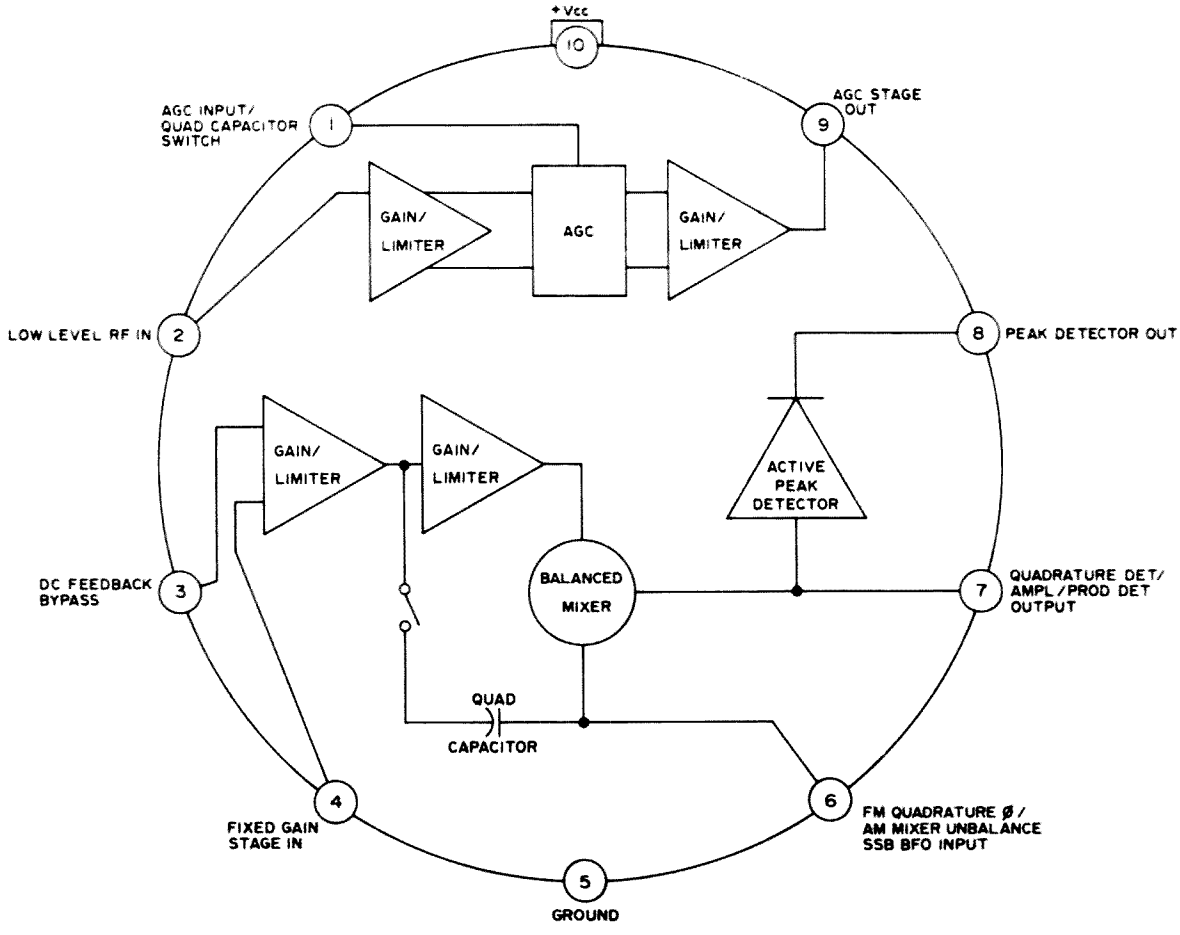


Fig. 1. Pin connections and internal wiring of theLM 373.

the connections used for operating in the AM mode. In order to disable the balanced mixer for this mode, an offset voltage is introduced at pin 6 by means of a resistor. Agc voltage is taken from the output of the peak detector and connected to the agc input at pin 1 through an RC network with the desired attack/decay characteristic. An agc range of 70 dB with operation down to 50 μV rms input is possible with this circuit.

For SSB/CW operation, refer to the block diagram of Fig. 3. A bfo signal of 25 mV rms or greater is fed into the balanced mixer at pin 6, causing the mixer to act as a product

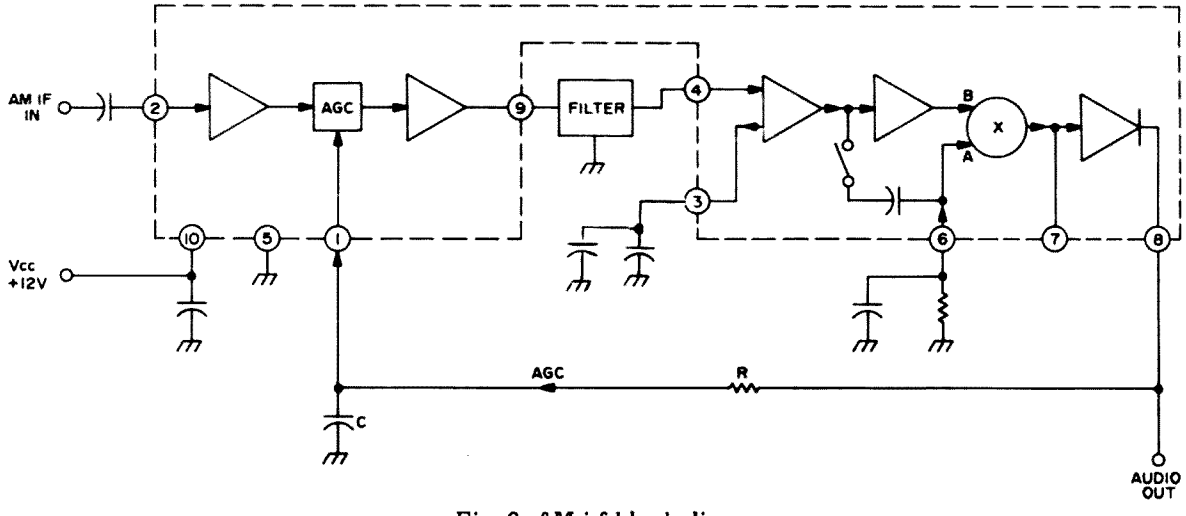


Fig. 2. AM i-f block diagram.

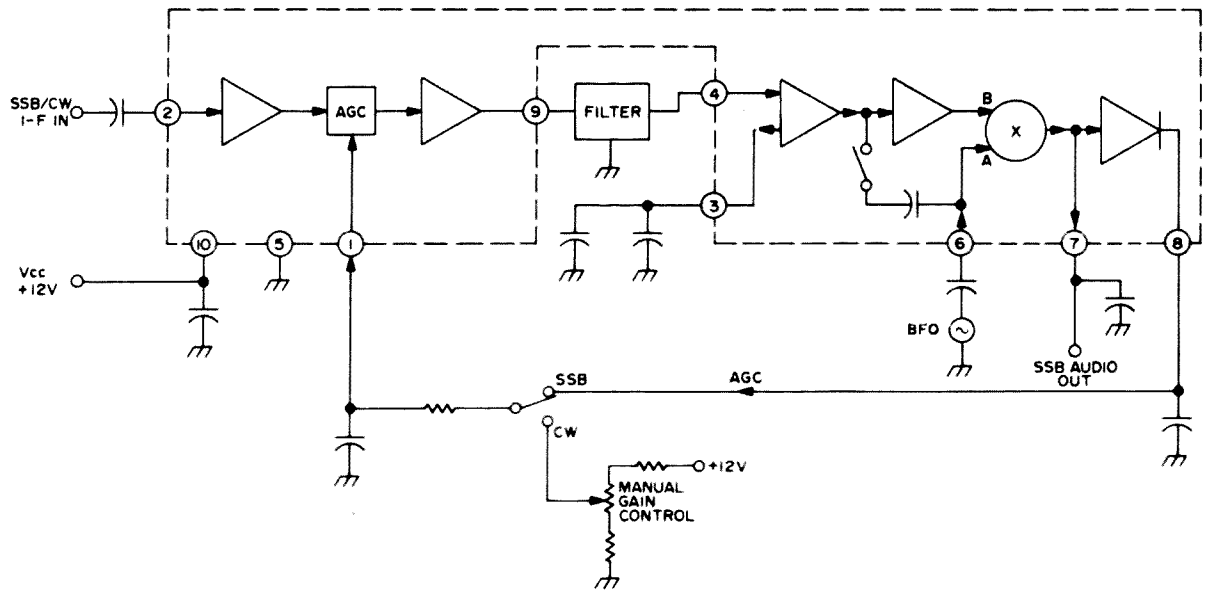


Fig. 3. SSB/CW i-f block diagram.

detector. The peak detector generates an agc voltage derived from the audio fed to it from the product detector. This voltage is fed back to the agc section through the RC network. A means of providing manual gain control for CW operation is also shown in the block diagram. So here we have an i-f amplifier, a fast attack, slow release audio derived agc system and a double-balanced product detector all in one neat package.

Although I have not tried the LM373 in an FM receiver, some readers may be interested in this type of operation and Fig. 4 is the block diagram for an FM i-f system. By grounding pin 1, the agc is defeated and all gain stages become symmetrical non-saturating limiters. This action also connects an internal quadrature capacitor to pin 6 which is also input A of the quadrature detector. An LC network tuned to the nominal i-f frequency is connected externally to pin 6. This network produces a frequency-dependent phase shift with respect to the signal at input B of the quadrature detector. A pulse duration modulated output is produced by the detector and integrated by the capacitor connected to pin 7. The Q of the quadrature network will influence both the output level and the distortion. For a given deviation, increasing Q will increase both output and distortion. At least a 50 mV rms signal is required at pin 6 to ensure switching action of the detector and maximum output. Audio at a higher level may be taken from the output of the peak detector at pin 8.

In addition to the applications above, this versatile IC may be used in several other interesting circuits. These include SSB generator with alc, constant amplitude/amplitude modulated rf oscillator, first i-f amplifier/

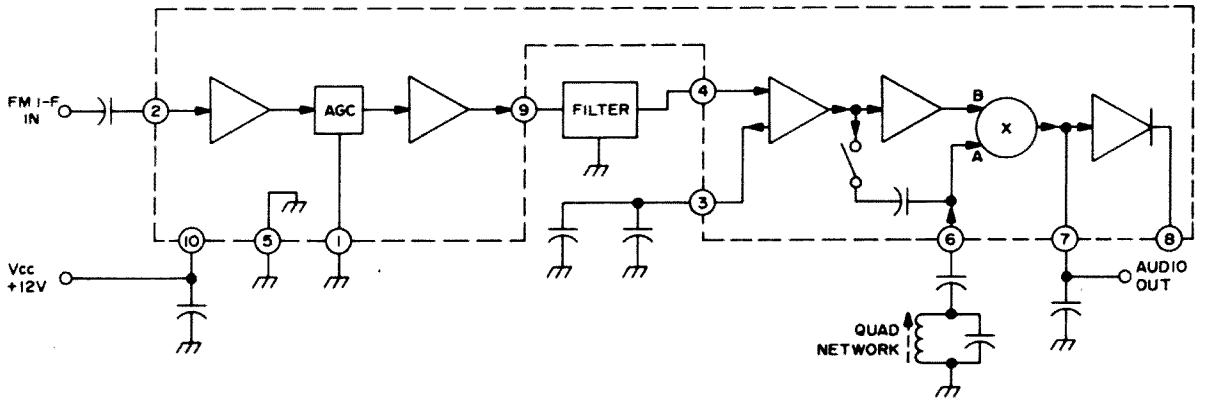


Fig. 4. FM i-f block diagram.

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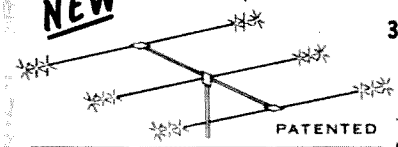
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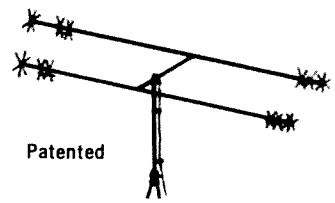
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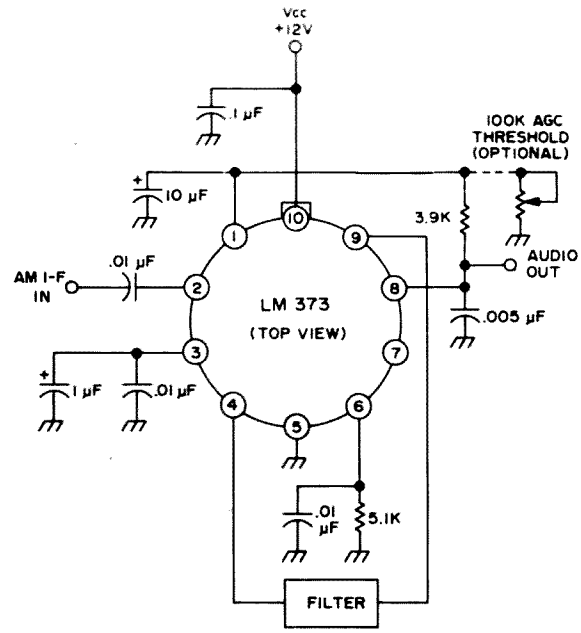


Fig. 5. AM i-f strip wiring diagram.

second mixer and as a video amplifier with agc, manual gain or gating. There are others too, but unfortunately we can't cover them all at this time.

If you are mainly interested in using the LM373 in your own designs, Figs. 5, 6 and 7 are schematics for use in the various modes discussed above. Notice that in all circuits, ac coupling is used for signal transfer. Dc paths in integrated circuits of this nature can cause excessive currents to flow, resulting in possible destruction of the IC. The bypassing at pin 3 should be accomplished with a low

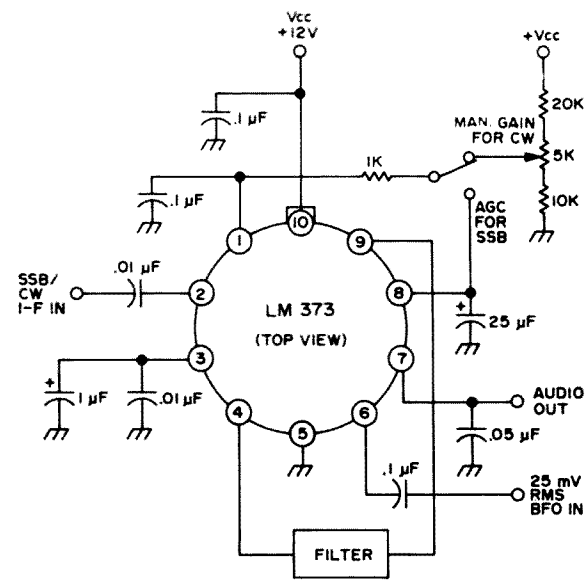
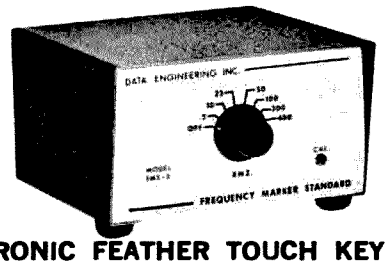


Fig. 6. SSB/CW i-f strip wiring diagram.

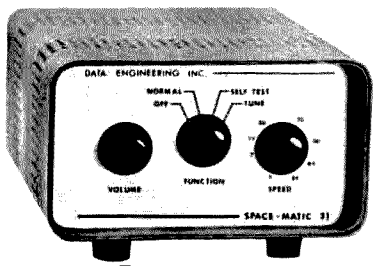
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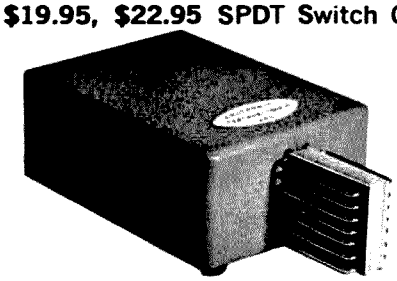
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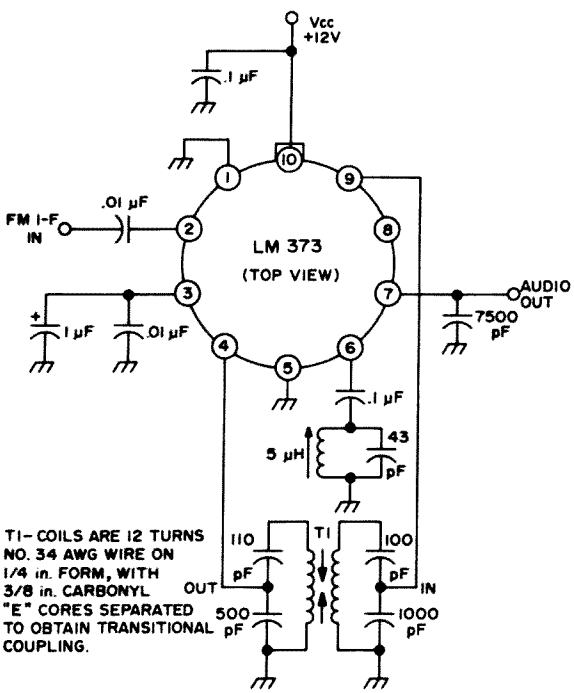


Fig. 7. FM i-f strip wiring diagram shown with transformer interstage coupling.

inductance high frequency capacitor and a larger tantalum for the low frequencies. You should also observe the usual rules of good layout practice and keep leads short when working with high gain circuits such as this.

Figure 8 is a schematic for the front end of the receiver I built using the LM373 in the i-f system. The rf and hf oscillator stages both use an inexpensive 2N3819 plastic junction FET. The mixer uses a dual gate MOSFET. Another 2N3819 is used as a source follower to isolate the hf oscillator and prevent pulling. A small transistor type i-f transformer couples the mixer to the LM373.

Figure 9 is a schematic for the remainder of the receiver; including the i-f, bfo and audio portions. In order to operate the i-f system in both AM and SSB modes, it was necessary to incorporate a 5-pole, 3-position switch, S1, to make the transfer. Two of the poles are used to switch the agc time constant components from AM to SSB. Another pole provides bfo input to pin 6 for SSB operation or an offset voltage for AM. Pole number 4 selects audio output from pin 7 for SSB or pin 8 for AM. The final section applies voltage to the bfo for SSB/CW reception. S2 is a small SPDT toggle switch

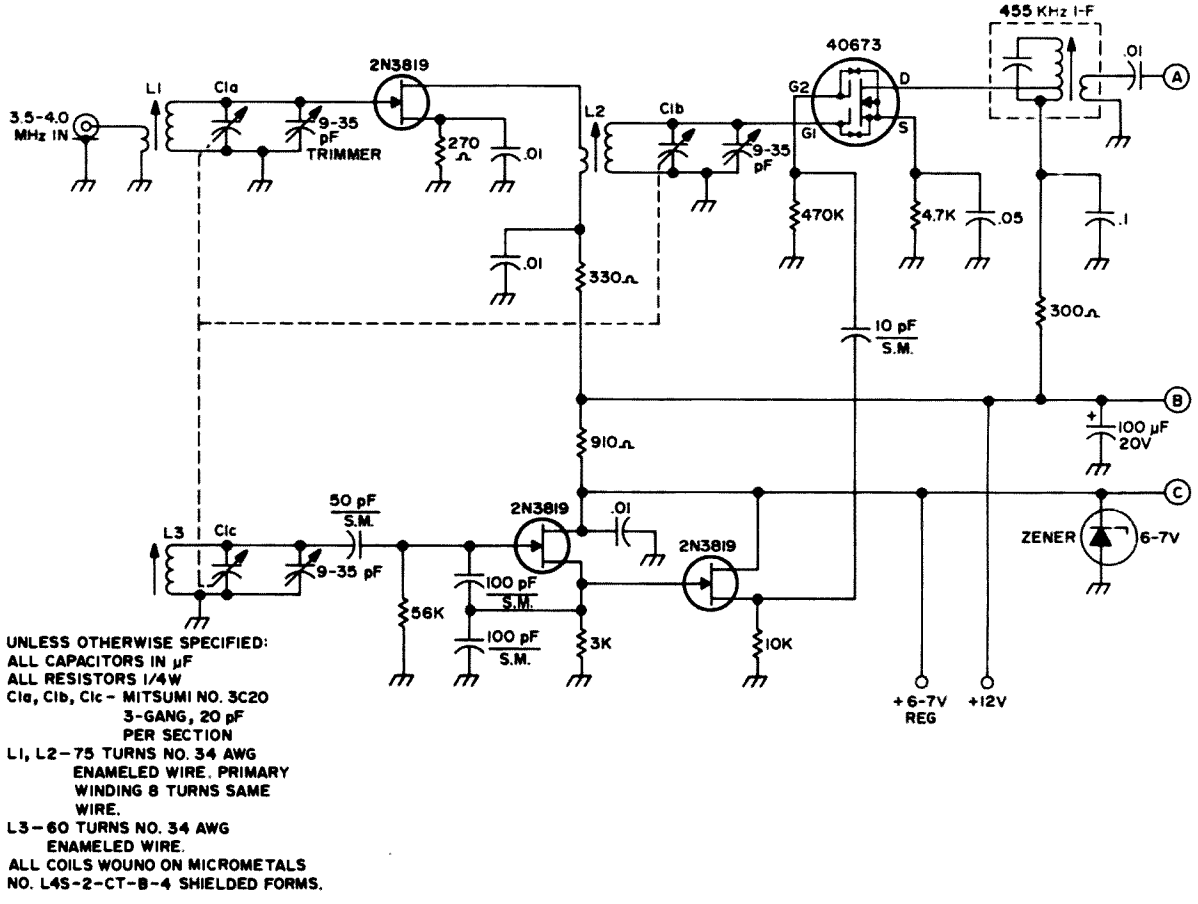
used to go from manual gain control to normal agc when in the SSB/CW mode. The manual gain control is useful when listening to CW.

A second i-f transformer is used for the bfo tank and is tuned by a dc voltage applied across a capacitor diode. I used a V47 but many ordinary silicon diodes will work satisfactorily in this application. Epoxy rectifiers are also a good bet. Depending on the frequency variation obtained, the 27 pF series capacitor may have to be altered for proper tuning range. If range is insufficient, increase the value of the series capacitor. If bfo range is greater than needed, a smaller capacitor may be used.

Operating voltage for the hf oscillator, the bfo and its tuning diode is regulated by a zener diode. Almost any small zener in the region of 6 to 7V may be used. The base/emitter junction of a silicon transistor makes an excellent zener and no doubt several can be found with 6 to 7V breakdowns. With these critical circuits regulated, the main supply can be varied from 9 to 15V without producing any noticeable change in the received signal other than audio output. A 2N3819 source follower further stabilizes the bfo.

Because I wished to keep size to a minimum, I used a tiny 455 kHz ceramic ladder filter as the interstage coupling device for the LM373. This filter, the Murata CFS-455J, has a 3 dB bandwidth of 3 kHz and is adequate for general use. I used a printed circuit board for assembling the receiver and arranged it to take either the ladder filter or a Murata SFD-455B dual section filter. This provides about 4.5 kHz bandwidth at 3 dB. Because this is not a construction article in the strictest sense, and because some of the components dictated board layout not compatible with most junkboxes, a printed circuit layout has not been included.

I incorporated an audio preamp since I like to have a little reserve when it is needed. This stage can use almost any NPN audio transistor and is not at all critical. The transistor I used was an unmarked refugee



UNLESS OTHERWISE SPECIFIED:
ALL CAPACITORS IN µF
ALL RESISTORS 1/4W
C1a, C1b, C1c - MITSUMI NO. 3C20 3-GANG, 20 pF PER SECTION
L1, L2 - 75 TURNS NO. 34 AWG ENAMELED WIRE. PRIMARY WINDING 8 TURNS SAME WIRE.
L3 - 60 TURNS NO. 34 AWG ENAMELED WIRE.
ALL COILS WOUND ON MICROMETALS NO. L4S-2-CT-B-4 SHIELDED FORMS.

Fig. 8. Schematic of the front end of K4DHC's receiver.

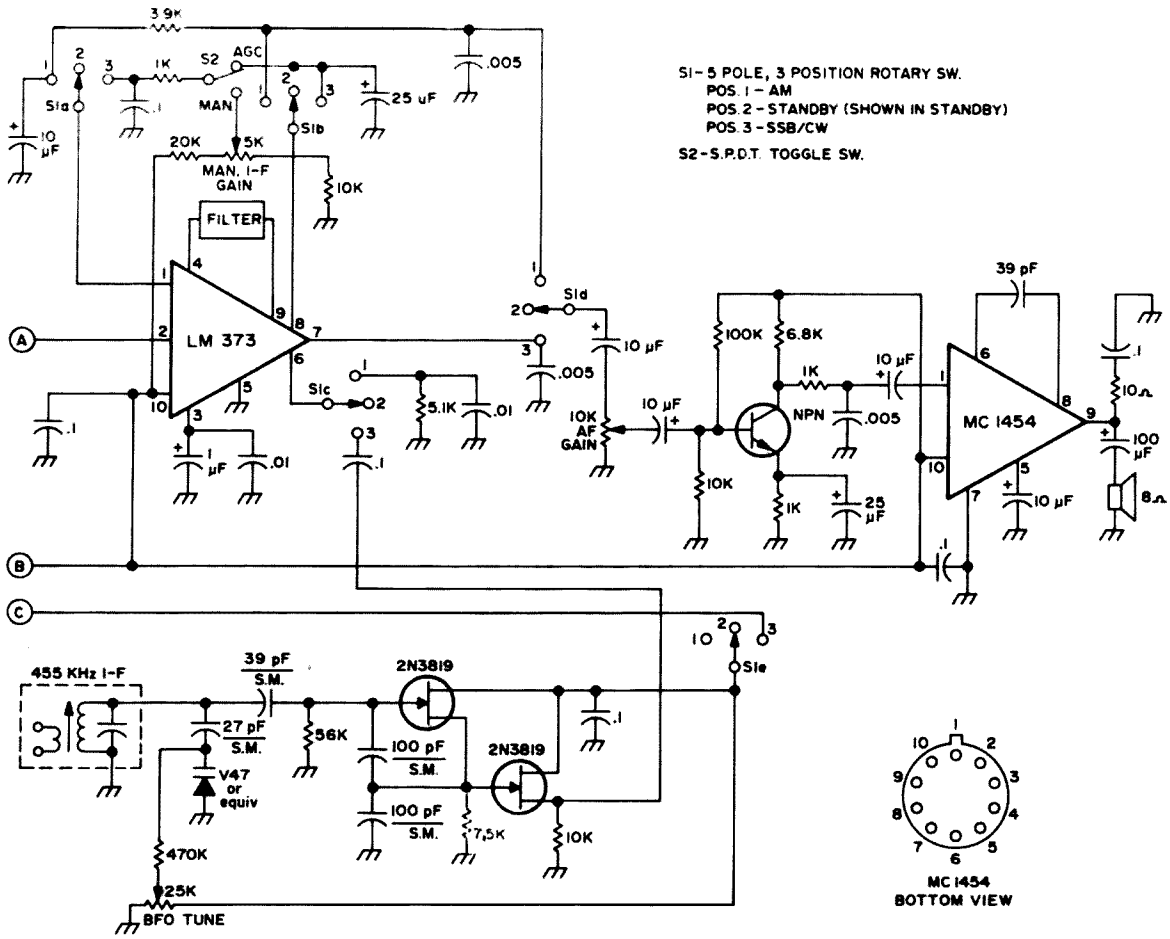


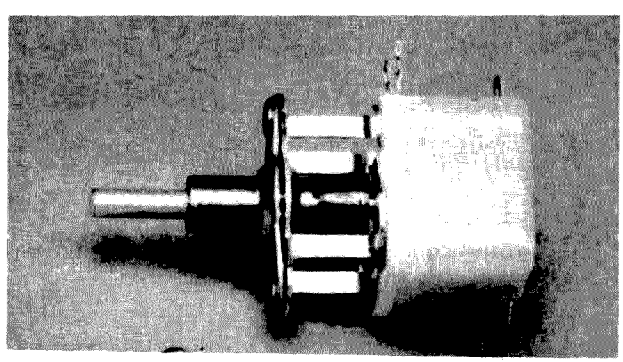
Fig. 9. Schematic of the bfo, i-f and audio portions of K4DHC's receiver.

from my junkbox. A Motorola MC1454 IC power amplifier is used in the audio output stage. It is capable of 1W of audio into an 8Ω load. I've had excellent results with this IC and have used it in many projects. The small speaker built into the receiver doesn't do the audio justice, but does make the receiver self-contained.

At present a block of 8 pen cells soldered in series powers the receiver. No-signal current drain is about 28 mA, rising to 40 or 50 mA on audio peaks at normal room level. At these levels it is not necessary to heatsink the audio amplifier.

Construction of the receiver is unorthodox in some respects because of my desire to keep it small. Since some of the ideas used here may be of interest to others, I'll go over the main points.

The front end tuning capacitor is a tiny 3-gang film dielectric type of 20 pF per section. It is driven by an equally small 4.5:1 ball drive attached directly to the tuning capacitor. Unfortunately, a pointer was not available for this drive but one was fashioned quite easily and can be seen in the photograph. The 3 trimmers, Erie style 538, were mounted on the capacitor and the whole assembly fastened to the front panel along with the other controls. This saved considerable board space and did not add anything to the space required behind the front panel.

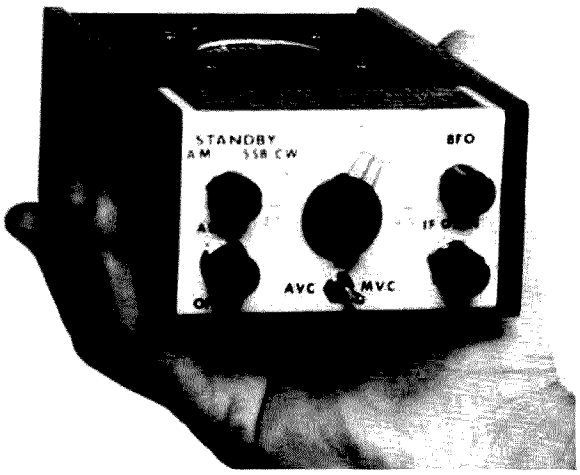


The 3-gang miniature tuning capacitor with reduction drive attached. Homemade pointer is push-fit over the large (direct) shaft.

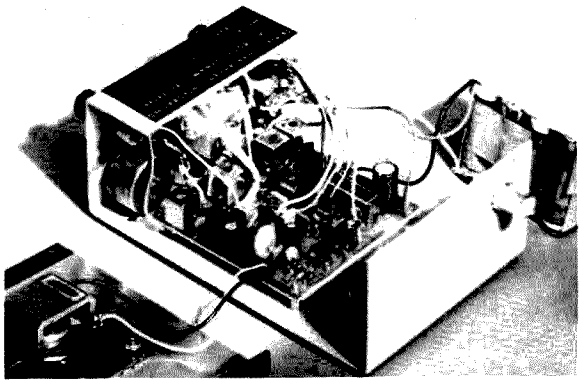
An additional saving was achieved by mounting as many components as possible on the mode selector switch, S1. Since panel area was scarce, I used a small diameter Japanese rotary switch having 3 decks with a total of 9 poles and 3 positions. This is a Lafayette part number 99F61715 which lists for only 79¢. Since it is a shorting type switch, it was necessary to use position 1 and position 3 of each section to avoid shorting circuits during transfer. An unexpected bonus resulted, however, when the middle position worked out fine for "Standby." Since the switch has many more contacts than required, unused lugs made convenient tie points for mounting the associated resistors and capacitors. With these savings, the printed circuit board for the entire receiver ended up being a 3-in. square.

I think that most will agree that the principal limiting factor in shrinking equipment size, is front panel space. Half-inch knobs seem to be the smallest practical size, and even then you need finger room in between controls. The Ten-Tec cabinet I used is the smallest of their JW series. Actual panel space is 2-¼ x 3-5/8 in. As can be seen in the photograph, there isn't much room left over.

If you build up a copy of this receiver and use the specified coil forms, a suggestion may be in order. After alignment is completed, put a small ball of coil wax in the opening of the oscillator coil and melt it down with the tip of a small soldering iron. The bobbins in these coil forms sometimes do not fit tight and cause microphonics or instability in the oscillator output. The wax holds the bobbin tight and prevents any of these problems.



K4DHC's miniature 75 meter receiver utilizing the LM373 in the i-f system.



Interior view of the receiver. The LM373 is just behind the i-f transformer in the middle of the board. The 3 kHz ceramic ladder filter is just to the right. The pen cell battery pack normally sits in the space between the board and back panel of the cabinet.

That covers the basic uses of the LM373 and may have set you to thinking about applying this versatile device to some of your own pet projects. It should be pointed out that the version discussed here is the limited temperature range LM373H in a TO5 can. Price is $4.85 in small quantities. A 14-pin DIP version, the LM373N, was to be made available at slightly lower cost but I hadn't checked on this at the time of writing.

For those who may be interested, I have a limitied supply of the uncommon components used in the receiver. This includes the 3-gang tuning capacitor, the ball reduction drive, Murata filters and shielded coil forms. Drop me a line for information.

Results to date using this i-f system have been quite gratifying. The LM373 provides more than adequate i-f gain at 455 kHz and the agc acts without any noticeable pumping. Overall, the use of this device has drastically cut component count while providing excellent circuit performance.

If you are wondering about the weird nameplate on top of the receiver, it came about because I had to cover some bad scratches and it seemed the only way to do it.

. . .K4DHC

Ken W. Sessions, Jr. K6MVH

REPEATER SITE BREAK-IN ALARM

. . .Lets you hear what the burglar is saying as he robs you blind.

It was very warm in my non-air-conditioned repeater building and I had been working through the most scorching period of the hottest day of the year putting in a new control system. I was tired and dusty and irritable and impatient. I just wanted to get home. So, when it was well past time for supper, I made a batch of temporary alligator-clip connections to keep the repeater operational and went on down the hill. Since I planned to return first thing in the morning, I left all my test equipment and tools at the site.

When tomorrow rolled around, I was still tired. The repeater seemed to be perking right along without any trouble, so I put off making the trek. It wasn't until a week had gone by that the repeater finally crapped out completely and I *had* to visit the site. And when I did, I wished I'd returned the day after my earlier visit. When I unlocked the building and went inside, I was stunned. My test equipment – some of it borrowed – was gone! My tools were gone! The only thing remaining intact was the repeater itself. I had been robbed!

Someone had either jimmied the door or somehow managed to unlock it. My initial

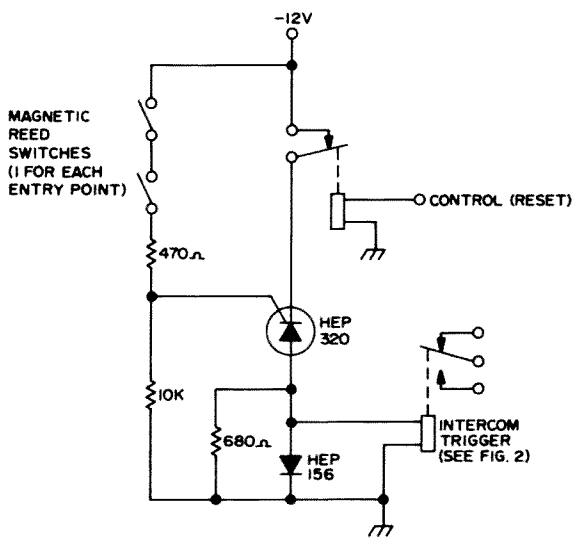


Fig. 1. Basic repeater intercom alarm. After the circuit has been triggered, any short pulse applied to the reset relay will cancel the alarm, resetting the system.

reaction, after that first shock wave, was fury – but not fury at the thief; I was angry with myself! I had a superb automatic communications system up there that could have been used to warn me of an unwelcome intruder. But I had not had the foresight to use it for that purpose. Then and there I made up my mind never to install another repeater without an automatic alerting device to let me know when the site is being "visited." Admittedly, that was like locking the corral after the steers have been rustled, but at least I could be relatively certain of hanging onto the next herd.

Getting an alarm into service was painfully simple – the fact of which simply served to make me even more upset with myself for not thinking of it sooner.

Thinking that the thief (or thieves) might return for more of my goodies some day, I decided to employ a warning system that was covert by nature; that is, I wanted to be alerted that someone was tampering, but I didn't want to alert the tamperer to the fact that I knew he was messing around where he didn't belong. So my idea was to use an intercom system connected to a door-actuated switch, which would key the UHF control repeater and let me actually hear what was happening on the hill. (I didn't connect the intercom to the regular open repeater because I couldn't help thinking that the thief *could* be someone who monitors and uses it – unlikely as that thought seemed to be.)

Alarm Circuit

The basic circuit I used for triggering the alarm system was similar to the one shown in Fig. 1. The circuit pictured here, developed by Motorola engineers as an automobile burglar alarm, draws less than 1 mA of constant current, so there's no need to worry about power requirements, even if your repeater is battery operated. Since the voltage required is on the order of 12V, a dropping resistor would be in order if you plan to operate from a 28V dc control system.

If your repeater site employs a UHF control repeater in conjunction with an open repeater in the VHF band, you'll probably want to employ the same operating philosophy that I used. I connected the alarm so that when it is actuated, the open repeater goes off the air and the control repeater goes on. This is accomplished by rerouting some of your existing audio connections. Cut the 2m push-to-talk lead that keys the UHF repeater and reroute it through the normally closed contacts of the alarm relay. Do the same with the 2m audio lead. The rerouted leads are shown in Fig. 2.

The way the system works is simple: The open repeater normally feeds signals to the UHF repeater through the alarm relay contacts. But when the alarm circuit is triggered, the UHF repeater becomes completely disengaged from the 2m repeater (even though the 2m system can continue to function independently, without UHF interconnect, if you want it to). The alarm circuit keeps the UHF repeater on the air until you, at the control point, transmit a tone command to reset the alarm.

While the alarm is actuated, the UHF transmitter mike circuit is being fed with a special homebrew microphone – comprised of an ordinary speaker and an output transformer. (The output transformer, by the way, can be any old tube-type "plate-to-voice-coil" transformer such as the type typically found mounted on the back of speakers in ac-dc broadcast-band radios.)

The higher the impedance of the mike side of the transformer, the better – but if you get hum, you'll have to use shielded wire and perhaps enclose the transformer in a chassis all by itself.

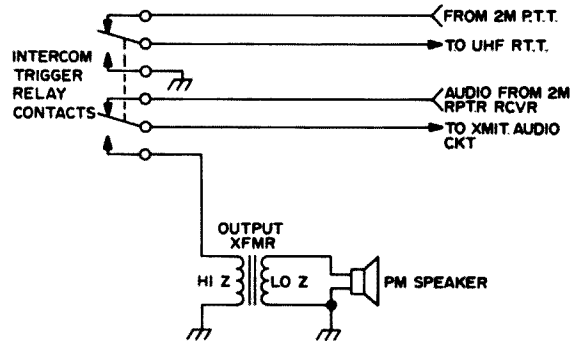


Fig. 2. The existing repeater-to-UHF audio interconnects should be reourted through the intercom trigger relay so that the UHF control repeater hears only the action at the site in the event of a burglary.

Make a few checks after you get the contrivance wired up just to see if the intercom is sensitive enough to pick up soft voices from anywhere in the repeater building. If not, just incorporate a simple audio amplifier between the speaker "mike" and the transmitter's audio line.

You may want to use the same approach I did with respect to keeping the mike hidden. I used the built-in speaker on the rpeater cabinet as the mike. (It doesn't have the best audio quality in the world and would never win any fidelity awards, but it did the job.) I installed a switch so that when I was working on the repeater I could use the speaker as it was originally intended. The hook-up for this is shown in Fig. 3.

If you use this technique, you'll have to remember to reposition the switch to the ALARM spot when you're ready to leave the site; otherwise you'll hear nothing when the burglar makes his appearance.

Triggering

Every repeater site has its own individual weaknesses from the standpoint of burglary susceptibility. Since my site had but one door and no windows, my problems were minimal. I simply installed a magnet on the door and a magnetic reed switch adjacent to it on the wall. If your site has more than one door, or a window or two, you'll want to install a magnetic reed switch at each possible entry point – or use the photoelectric alarm approach described later.

There's no requirement for using magnetic reed switches, but they offer the advantage of being very small and highly reliable. Also, it will mean that you won't have to run a wire across the door itself.

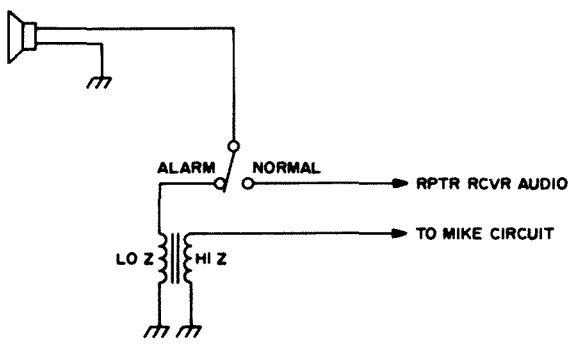


Fig. 3. A simple switch can be used to make your repeater receiver speaker double as an intercom microphone.

Relays

The reset relay should be capable of operation from whatever dc control voltage your particular repeater system uses. Since nothing more than momentary opening of the contacts is required, virtually any control system that can provide a short voltage pulse on command will be adequate.

The intercom trigger relay is a Potter-Brumfield type RS5D, which has a 6V dc coil whose resistance is 335Ω. You should stick to that relay or its equivalent if you don't want problems. A lower value of coil resistance could cause excessive current to be drawn, possibly resulting in thermal destruction of the semiconductors. Higher resistances are all right, of course, but make sure the relay contacts will be able to handle the loads you'll be switching. The P-B relay shown can handle loads of up to 2A, which should be more than adequate for the push-to-talk and audio requirements of most repeaters.

The diode across the relay coil provides a discharge path for any induced voltage spikes. Without it, the coil's collapsing field can generate a momentary high-voltage spike that might be too much for the semiconductors in the circuit. Don't install the diode backwards, either, or the diode will shunt the direct current around the relay coil directly into the SCR – which could mean curtains for your HEP 320.

Alternate Approach

If your site doesn't lend itself well to installation of magnetic reed switches, or if there are other groups who use your building, you might want to try a protection system that is less likely to be triggered inadvertently. One such method involves the installation of an "electric-eye" across the area in the building adjacent to where your repeater is located.

If you use this approach and there are other lessees in the same building, be sure to let them know of the alarm so they won't trip it when they're working on their own equipment.

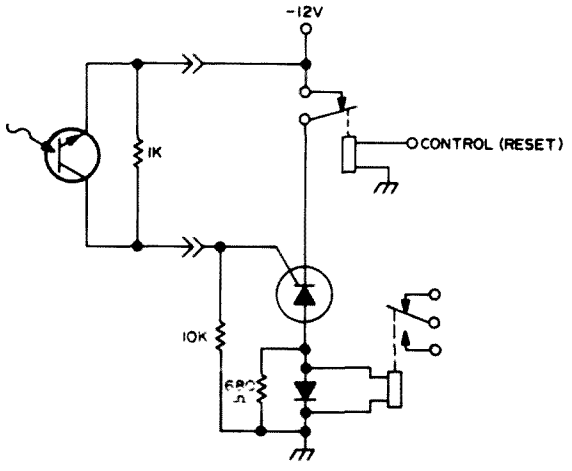


Fig. 4. The alarm circuit can be easily adapted to a photodiode beam-type protection arrangement by replacing the reed switches with a photodiode and a resistive shunt.

As you can see by comparing Figs. 1 and 4, there aren't many differences between the two alarm systems. All components that are unmarked in Fig. 4, as a matter of fact, are of the same value as those shown in Fig. 1.

You'll need a simple lens assembly to focus light from the source across the access path to the photodiode. This shouldn't prove any great problem, though, because any old flashlight should prove capable of handling that job with ease. You won't want to use batteries, of course, because they'd be gone before you could even get to the bottom of the hill. Just replace the batteries with a dc voltage from your normal control system.

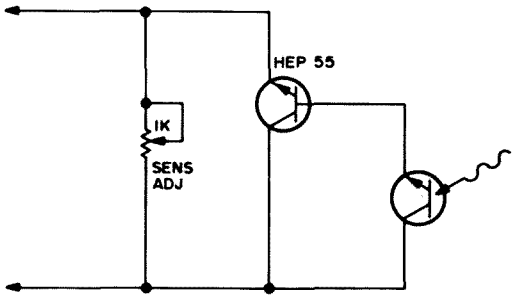


Fig. 5. Addition of a HEP 55 amplifier and substituting a pot for the fixed resistor in Fig. 4. will considerably increase the sensitivity of the circuit and will permit the light beam to span a greater distance.

If the flashlight can't provide a good, fairly high-intensity spot of light, you can modify it by moving the bulb back and forth within the reflector until an effective spot is obtained. Most flashlights will be good for about 6 ft. You can increase the sensitivity of the alarm circuit, though – thus increasing the beam distance capability – by adding a simple amplifier circuit as shown in Fig. 5.

The high-sensitivity amplifier and photodiode go into the circuit at the point in Fig. 4. where the photodiode and 1 kΩ resistor are connected. As you can see, the 1 kΩ resistor is still in the circuit, but now it's in the form of a pot so that circuit sensitivity can be adjusted.

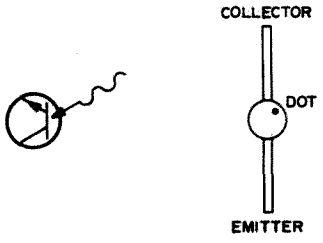


Fig. 6. Photodiode symbol and bottom view of Motorola's HEP 312.

If you haven't worked with photodiodes before, you might not be familiar with their layout. Figure 6 shows the symbol and the lead layout of the HEP 312. As you can see, the photodiode is a two-lead device, and it consists of a single PN junction. When light strikes the little collimator lens, current flow across the junction increases. With the junction reverse-biased, the increase is substantial.

Naturally, the lens of the photodiode has to be oriented for best light-capturing ability. If the repeater site is well illuminated, you'll have to put a lttle tubular shield around the diode to keep it from being triggered by extraneous light.

Semiconductor Availability

All the Motorola HEP devices described in this article are available from *Circuit Specialists, Inc., Box 3047, Scottsdale, Arizona.* The magnetic reed switches are available from *GC Electronics, Division of Hydrometals, Inc., Rockford, Illinois 61101.*

. . .K6MVH

John G. Oehlenschlager KØMOC
394-D Ricketts Road
Monterey CA 93940

MOTOROLA T44 BASE STATION CONVERSION

Conversions of the Motorola T44 450 transceiver to 100V probably come in as many versions as there are persons converting them. Although not guaranteed to be the ultimate, this conversion does offer two distinct advantages, simplicity and versatility. A very minimum of time and components is required. Most of the parts are readily available from the average junkbox. The only items which may present a problem are the 6.3V transformers. The conversion in no way impares the operation of the T44 on 6/12V dc. All that is necessary to change from mobile to base station is to remove the vibrators and insert the jumper plugs, and position the control voltage selector to ac. Fuses F3 and F4 must be replaced with 20 amp fuses.

The first step in the conversion is to prepare the two vibrator jumper plugs. Any of several methods may be used; however, the easiest method is to cannibalize a pair of burned out vibrators for their bases or use an old 7 pin tube base. Alternatively, short pieces of 10-gage wire will fit into the vibrator sockets quite nicely. The function of the jumper is to short pins 1 and 5 to pin 7 (ground). (See Fig. 1)

The next step is to locate the small brown wire connected to terminal 3 of terminal strip TB1. (TB1 is the second transverse terminal strip from the front of the power supply.) Unsolder this brown wire from terminal 3 and move it to terminal 6 of TB1. Then wire in selector switch, connecting the two diodes and capacitor as shown in Fig. 2.

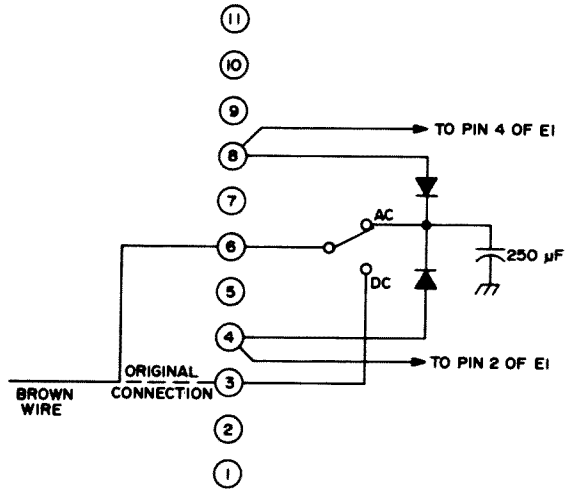


Fig. 2. Terminal board 1 (TB1)

Then connect terminal 8 to pin 4 of the vibrator E1. Connect terminal 4 to pin 2 of vibrator E1. Schematically the changes are shown in Fig. 3. This completes the equipment conversion. *(cont. on page 103)*

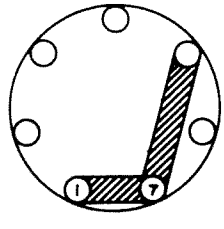


Fig. 1. Jumper plugs.

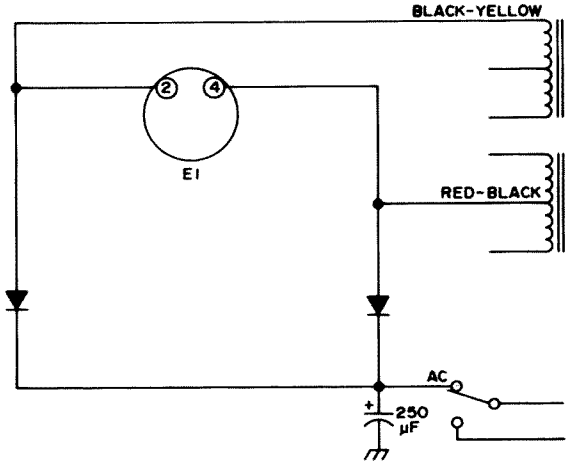


Fig. 3. Schematic of modification.



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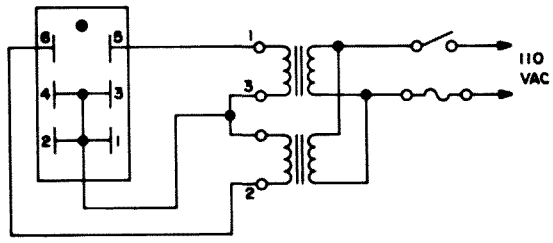


Fig. 4. External power supply.

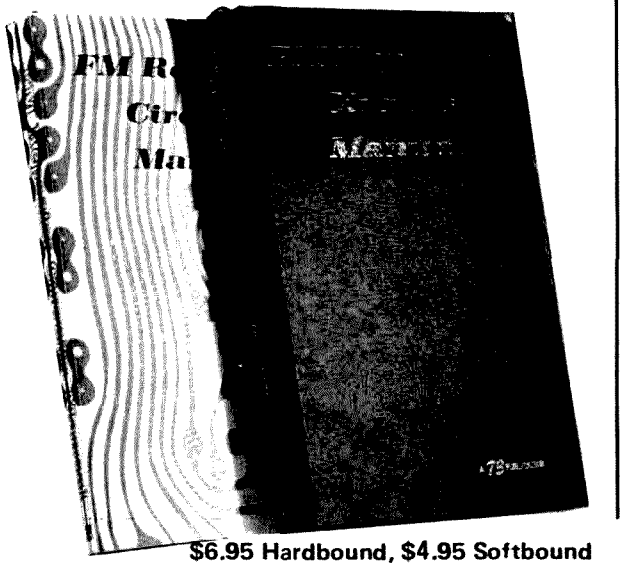
The final step is to build the external power supply. Since this is to be a base power supply, it might be handy to build the power supply and the control head into a single unit. I will only show the power supply portion. The rest will be governed by imagination, pocketbook or your Frau's aesthetic desires. The major ingredients are the two 6V-18 amp transformers. The external power supply schematic is shown in Fig. 4. The phasing of the 6V windings is important. When properly phased, the voltage from point 1 to ground and point 2 to ground should be 6V, and the voltage from point 1 to point 2 should be 12V.

. . .KØMOC

REPEATER CIRCUITS MANUAL

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James P. Weir, Jr. WB6BHI
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Fixed Base Operation of the HR-2 Transceiver

he Regency HR-2 Mobile Transceiver is a fine, high-quality piece of mobile 2-meter FM gear.[1] However, its "no-frills" design allows for quite a bit of individual leeway in the modification of the HR-2 for base station use.

Power Supply

Since the HR-2 operates from +12V dc, the first order of business is the design of a power converter between wall juice (117V ac and 12V dc.)Figure 1 shows the schematic diagram of a supply designed to give 13.0V on transmit and 13.4V on receive. T1 is any transformer that will give 16–19V ac out at 2 amps. There are several companies[2] that make such transformers, or a 12.6V and 6.3V filament transformer may be wired in series to give the required voltage. Diodes D1 through D4 form a full-wave bridge rectifier. C1 is a 7000 μF filter capacitor (I used seven 100 μF capacitors in parallel.) Any combination yielding over 6000 μF of capacity should work to remove the ripple from the bridge rectifier. Q1–Q2 form a regulator-filter to regulate the +22 down to +13V. When the transceiver is on transmit, 25W is dissipated in Q1, so be sure to heat-sink it well. Q2 will draw a healthy slug of current under accidental short-circuit of the output, so heat-sink it well also. D5, D6 and the emitter-base junction of Q2 set the output voltage, and they must add up to the desired output voltage (12.0 + .7 + .7 = 13.4V output). R1 is used both as a surge-limiting

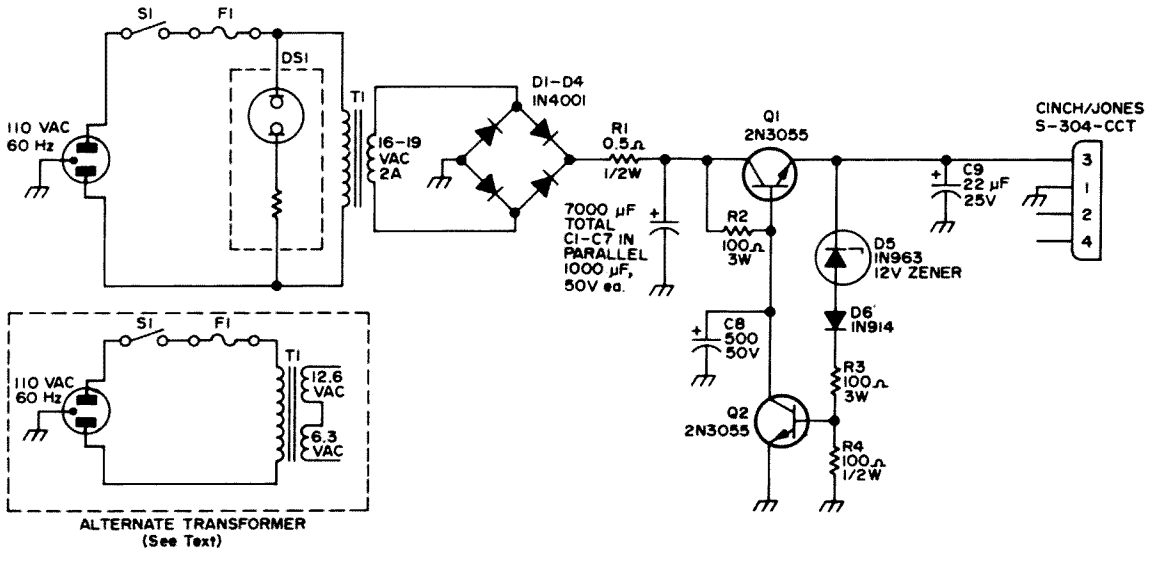


Fig. 1. Ac power supply. Parts data –C1–C7: 1000μF 50V dc; C8: 500μF 50V dc; C9: 22μF 25V dc; D1–D4: IN4001 50 piv lamp; D5: IN963 zener diode, 12V; D6: IN914 silicon diode; I1: neon panel lamp assembly; F1: 1A slo-blow fuse; Q1–Q2: 2N3448 or 2N3055; R1: 0.5Ω ½W; R2–R3: 100Ω3W; R4: 100Ω ½W; T1: 117V – 16 to 19V at 2A.

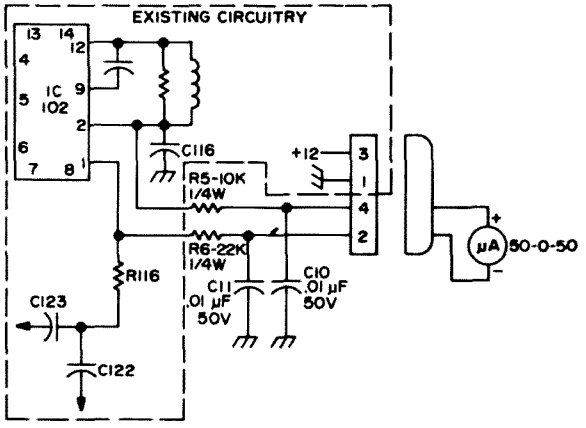


Fig. 2. Installation of zeroing meter. Parts data – R5: 10 kΩ ¼W; R6: 22 kΩ ¼W; C10–11: .01 µF 50V dc; M1: 50- 0 - 50 µA panel meter.

resistor and as a current-sensing resistor to be used later. Do not use a lower valve for C8 than 500 µF, or the supply may oscillate and self-destruct Q1 and Q2. Power connections are made to pins 1 (ground) and 3 (+12) of a female 4-pin Jones plug (note – the instruction manual shows pin 1 to be +12 and pin 3 to be ground – it might be wise to check the internal wiring of your HR-2 before you hook up the power cable. Mine was wired the opposite from the manual.) The extra pins (2 and 4 of the Jones power plug) will be used later as output to the zero-center meter.

Zero-Center Meter

Another "frill" useful as a base station accessory is a meter in the discriminator circuit to detect the relative error of other stations or for "zeroing" another transmitter frequency. Figure 2 shows how this modification is accomplished. IC 102 is the original discriminator, with output at pin 1. Pin 2 is

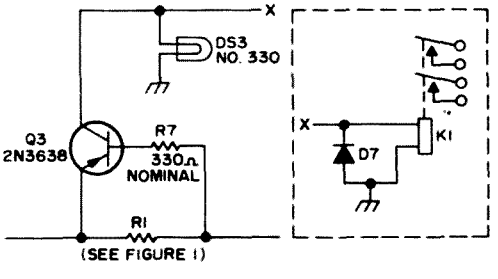


Fig. 3. "Transmitter On" light modification. Parts data – D7: 1N4001 diode; 12: 12V pilot bulb; Q3: DNP 2N3638; R7: 330Ω ¼W nominal (see text); RL1: 12V relay.

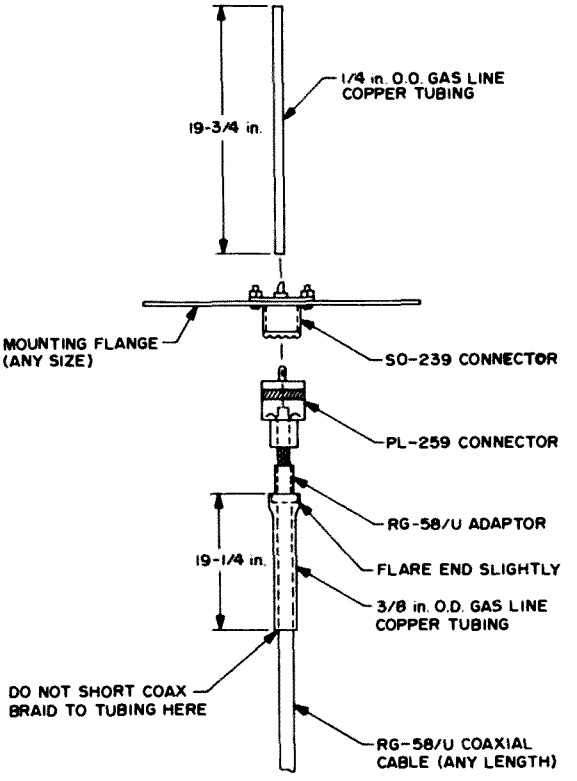


Fig. 4. Fixed station antenna for $1.

a constant dc voltage representing zero frequency error. Pin 1 varies about this voltage plus or minus depending on whether the received frequency is high or low. Decoupling filters R5-C10 and R6-C11 provide the necessary isolation and meter multiplication for a full-scale deflection of M1 at ±25 kHz frequency error.

Transmit Indicator

Under certain circumstances, a "transmit" indicator is useful. It may prevent inadvertent keying of the transmitter or a stuck microphone button putting out unwanted A1 emissions.

Figure 3 shows the addition of the 3 parts to the power supply for this "transmitter on" light. When the current through R1 increases above an ampere or so, Q3 is turned "on," and provides current to lamp 12. The current through the lamp is set by R7 to give a normal, above normal, or less than normal brilliance. Q3 is thermally adequate for the most normal operations,

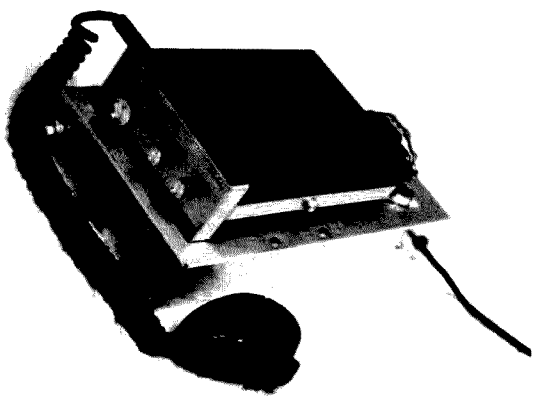
but you may wish to heat-sink the device or use a heftier device if you are particularly long-winded. A 12V relay (shown on the schematic inset) may be substituted in place of the light to control other functions, such as +12 to an external power amplifier, a 110V light bulb, or other "power" devices.

Antenna

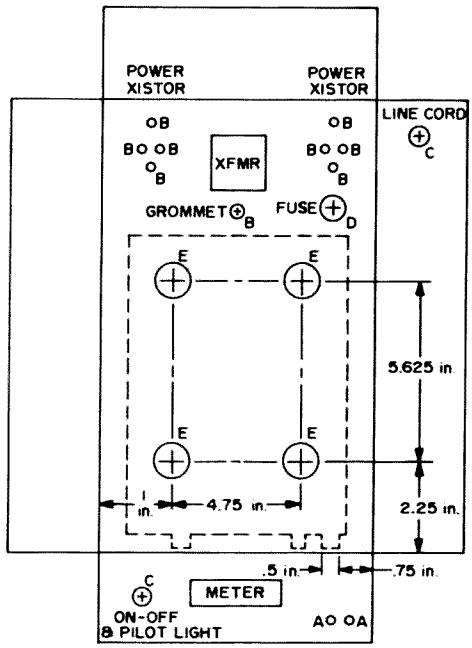
Since the use of the transceiver as a base station is an off-and-on thing, no great pains were taken to make the ultimate in gain or match with the base antenna. Figure 4 shows how a dollar's worth of goodies (except cable) makes a fairly respectable antenna with a resaonble vswr (less than 1.5:1) across the 146–147 MHz band (less than 2:1 from 144–148 MHz). Tuning is non-critical, and the gain is slightly superior to the more complex groundplane[3]. The basic construction is that of a coaxial sleeve monopole. One-eighth in. copper gas line is used for the radiating element and 3/8 in. gas line is used for the sleeve. These lines are available at your local auto parts house or "do-it-yourself" handyman shop for about 25¢ a foot. The SO239–PL259 are standard items at the local surplus shop or radio parts shop.

Construction

The photograph shows the completed base station. A 7x2x13 in. chassis was selected so that the transceiver could be set on it to form the base plate. The power supply components are mounted in back of the transceiver on the chassis, and the underneath of the chassis is almost entirely taken up by filter capacitors. Figure 5 shows the drilling template I used to drill and punch the chassis.



Completed unit.



HOLE CHART		
SYM	SIZE (DIA)	QTY
A	1/8 in.	2
B	1/4 in.	9
C	3/8 in.	2
D	1/2 in.	1
E		4

Fig. 5. Drilling template for home station adaptor.

Layout and parts placement may vary widely from my design; there are no critical parts placement problems with a dc power supply such as this one. However, keep C8 close to the base of Q1 to avoid the aforementioned stability problems.

Final Test

Before plugging the transceiver in, load the power supply output with a 10Ω 10W resistor and measure the dc voltage. It should be 13V ± the tolerance of your zener. No load voltage should be 13.4V ± the tolerance. A final check of the antenna vswr, and your excellent mobile rig is now an excellent base station also.

. . .WB6BHI

References:

1. "Regency: An FM Late Starter," Sessions K6MVH, 73 Magazine, p.96, December 1970.
2. Triad F6OU ($7.68), Stancor RT-201 ($7.40).
3. "Brew 1 on 2," Robinson WAØRWQ/6, 73 Magazine, p.86, September 1970.

1972 REPEATER LIST

The entries in this list are correct as nearly as we can manage right down to press time for this issue. Between indifference on the part of repeater managers and clubs toward getting their repeaters listed, a daily change in channels and the appearance of new repeaters on an almost daily basis, no list can ever be perfect. The list presented here is by far the most up to date available anywhere . . . and you merely have to keep tab on the repeater update column in the monthly 73 newspages to keep this list in near-perfect shape.

We ask that you take it upon yourself to let us know at 73 if you find any errors in the listings presented . . . or if you hear of any repeaters coming on the air that we do not have listed . . . or any changing frequencies . . . or going off the air. Send us a card, a QSL, a note, a letter, or even a radiogram via the traffic nets . . . but send. The more accurate we can keep this list the more valuable it will be to everyone . . . and the more fun we will all have with FM . . . the Fun Mode.

Repeater access methods are listed so: T1.95 means tone burst, 1950 Hz; W1.7, whistle-on center frequency 1700 Hz; TT, touchtone access (consult repeater club for access code); PL, private line (consult repeater club for exact frequency or reed number). Frequencies are listed so: figures in the last column (e.g., 34–94) refer to the 146 MHz segment of the two meter band. If different segments are used in the input or output or both, frequencies are listed with UHF, six meter, ten meter or 220 MHz frequencies.

ALABAMA

WA4AHX	Albertville			34–94
				20–76
WB4QEX	Birmingham			34–94
W4ZBA	Demopolis W1.8			34–94
	W1.8	52.76	52.525	
		440.00	449.00	
K4SPP	Green Mt.	146.94	147.54	
K4IQU	Huntsville T			46–94
WB4QEV	Mobile			34–94
W4JNB	Muscle Shoals			34–94
WB4QFR	Phenix City W1.8			28–88

ALASKA

—	Anchorage			34–94
—	Nome			34–94

ARIZONA

WA7HUH	Globe CLOSED			
WA7KUM	Globe CLOSED			
K7ZMA	Kingman			34–94
WA7CEM	Phoenix			34–94
				16–76
		449.30	445.30	
K7VOR	Phoenix			94–28
W7AJU	Prescott			34–94
				16–76
WA7KYT	Sierra Vista CLOSED			
K7PQI	Tucson			34–94

ARKANSAS

WA5YUT	Ft. Smith			34–94
W5ZF	Hot Springs			29–88
W5DI	Little Rock			34–94

NORTHERN CALIFORNIA

W6CX	Alamo	147.80	147.06	
K6KDU	Auburn CLOSED			
W6TI	Castro Valley	147.96	147.18	
WB6DGJ	Eureka			34–94
WB6QVV	Forest Hills T1.8	51.60	51.00	
WB6HYL	Fresno			34–94
		146.34	52.525	
		52.525	146.94	
W6JPU	Fresno	51.725	51.125	
		146.12	147.71	
		146.85	147.71	
		448.00	449.93	
WA6RDY	Fresno	146.46	147.84	
WA6UGS	Grass Valley T2.25			34–94
WA6ZOF	Kentfield CLOSED			
W6DOO	Los Altos	146.85	147.71	
WB6LJR	Los Gatos CLOSED			
WB6EMJ	Merced			06–76
K6LY	Monterey			37–97
WB6ZQI	North Highland			16–76
WA6RYO	No. Sacramento			80–20
WB6AAE	Oakland			20–80
	T1.95			94–94
		449.50	444.50	
WB6NDJ	Oakland T	51.70	51.075	
		50.40A	51.07	
WB6QEO	Oakland CLOSED			
K6SWS	Oakland T1.8			34–94
K6YVY	Oroville			34–94
WA6TSM	Palo Alto			13–73
		448.45	443.45	
WA6YCZ	Palo Alto CLOSED			
W6ECE	Paradise	147.00	146.49	
WB6SXC	Petaluma	145.98	146.90	
		448.60	443.60	
K6MIA	Redding	145.22	147.20	
K6QFO	Redwood City T1.8	51.90	51.35	
		146.31A	146.49F	
WB6ZRR	Richmond	146.40	145.47	
W6GDD	Rio Linda			34–94
WA6UGY	Rio Linda CLOSED			
WA6JCW	Sacramento	146.?	UHF	
		51.00	UHF	
K4TXK/6	Sacramento	52.76	52.525	
		52.76	443.00	
		52.525	443.00	
W6AQU	Salinas	146.60	147.60	
WA6BTH	San Bruno	11.90	51.35	
WB6OQS	San Jose T2.4			16–76
		449.60	444.60	
WA6UFE	San Jose			04–52
K6GWE	San Rafael			10–70
		448.25	443.25	
		145.10A	146.70F	
WA6UGM	San Rafael	51.00	51.00	
		51.30	51.30	
WB6IAG	Santa Clara T2.55			34–94
W6AEX	Suisan CLOSED			
WB6WYI	Vacaville T2.1	51.60	51.00	
K6JGE	Watsonville	146.928	147.60	

SOUTHERN CALIFORNIA

K6SYU	Anaheim			52–19
		145.62A	145.49F	
K6APE	Bakersfield T1.7	145.25	146.75	
WA6UJK	Bakersfield	145.155	146.90	
WB6SLR	Blue Ridge	146.94	449.15	
		146.46	449.15	
		146.94	449.475	
		146.46	449.475	
WA6FNT	Crestline			94–94
				76–76
				46–46
				34–34
WB6OPG	Exeter T1.8			16–76
	T2.2	145.20	146.82	
K6SJF	Goleta	146.16	146.995	
WB6ZDI	Hollywood Hills	146.61	147.33	
W6AOE	Idyllwild CLOSED			
W6FNO	Johnstone Peak			82–70
WA6CHZ	La Crescenta	145.15	146.49	
K6CPT	Los Angeles	145.66	145.30	
		147.28A	145.30F	
WA6FLH	Los Angeles	146.22	147.39	
K6MYK	Los Angeles	146.98A	145.22A	
WA6NUD	Los Angeles			34–94
K6ROC	Los Angeles CLOSED	RACES		
WB6TXX	Los Angeles	224.82	221.70	
WA6UJS	Los Angeles	52.76	52.525	
		52.525	449.95	
WA6UPB	Los Angeles	145.17A	147.66A	
		221.94	146.66	
WA6ZOC	Los Angeles	224.82	221.74	
		224.82	146.40	
WB6VYT	Los Angeles	224.82	146.40	
WA6TDD	Mt. Wilson	145.425A	146.40A	
WA6ZNL	Norwalk CLOSED			
WB6GUA	Palmdale T1.8			34–94
WB6ZON	Palos Verdes CLOSED			
WA6URI	Riverside			16–88
WA6LNU	Saddle Peak	221.63	223.00A	
WA6TIC	Saddle Peak RTTY			58–70
WA6ALV	San Bernardino T1.8			34–85
WB6WLV	San Diego T2.1,PL			34–85
		445.25	449.50	
W6SD	San Fernando Vlly	440.50	445.50	
WB6TSO	San Luis Obispo			20–80
K6TAZ	Santa Barbara			34–94
WB6YZV	Santiago Peak CLOSED			
W6FHF	Santiago Peak CLOSED			
WB6ZRQ	Sierra Peak CLOSED			
WA6SIN	Sulfur Mtn. T1.95			28–88

WA6TTL	Silver Peak			34–94
		52.525	146.94	
		146.94	52.525	
WB6OPH	Visalia	51.336	52.80	

COLORADO

WØIA	Boulder T1.8			16–76
		444.55	449.55	
WBØERV	Buckhorn			25–85
WØJGL	Castle Rock			07–67
WAØBAG	Colorado Springs			16–76
WØWYX	Colorado Springs			34–94
				16–76
		53.00	52.525	
		444.45	449.45	
WAØNVU	Denver	UHF		
KØOVO	Denver T1.8	146.82	147.30	
WAØVVC	Denver	444.35	449.35	
WAØVUO	Denver			04–64
WØPRZ	Grand Jct.	145.32	146.94	
WAØSNO	Pueblo			34–94
				28–88
KØPHF	Pueblo			28–88

CONNECTICUT

WA1KHK	Avon			28–88
WA1JTB	Bridgeport			31–88
W1NHK	Columbia (CD)	145.47	147.09	
WA1KGB	Farmington			37–97
K1IGF	Groton			19–94
WA1NQP	Naugatuck	444.2	449.2	
WA1KGD	New Haven			01–61
W1CDO	Ridgefield	441.85	446.85	
WA1KGK	Trumbull			16–76
W1CH	Torrington	443.80	448.80	
WA1KHA	Torrington			25–85
WA1KGQ	Vernon			19–79
		52.76	52.525	
		443.3	448.3	

DELAWARE

K3SVA	Delmar			22–82

FLORIDA

WB4KVV	Boca Raton T			34–76
W4IKB	Chipley			34–94
W4AB	Ft. Lauderdale			22–82
WB4EQU	Ft. Walton Beach W1.8	29.44	29.64	
WB4KLT	Ft. Walton Beach T1.8			34–76
WB4KNQ	Merritt Island			28–88
		443.10	448.10	
WB4HAA	Miami			34–76
		448.20	146.76	
WB4GLK	Okeechobee			34–94
				94–76
WB4QEL	Orlando			34–76
WB4QER	Panama City W2.0			34–76
WB4QEQ	Pensacola T2.2			34–76
WB4IES	St. Petersburg CLOSED			
—	Starke			34–94
—	Tallahassee			34–76
WB4HAE	Tampa			34–76
		448.20	146.76	
WB4QEN	Tampa	441.10	449.10	

GEORGIA

W4BQC	Atlanta T1.8			34–76
W4DQC	Atlanta			22–82
WB4NST	Atlanta CLOSED			
WB4KLM	Augusta			34–94
W4VQ	Rome W			34–94
				46–94
W4RRW	Smyrna			28–88

HAWAII

KH6EQF	Honolulu			20–80
		52.525	53.52	
		449.15	444.15	
KH6EQR	Lualualei			16–94
KH6EQK	Mt. Haleakala			34–94
KH8EDL	Waialua			20–80
KH6FOX	Waikiki			16–76
KH6NLH	Waipahu			16–76

IDAHO

K7ZZL	Deer Point			34–94
—	Orofino			34–94

ILLINOIS

WA9EAW	Aurora CLOSED			
WA9WVA	Batavia CLOSED			
WA9GCK	Bloomington			22–94
WA9DZO	Chicago PL			10–85
WA9DZT	Chicago T1.8	52.76	52.64	
WA9EAP	Chicago	Mobile 147.45	147.75	
		Base 147.50	147.75	
WA9ORC	Chicago			16–76
—	Chicago	147.40	147.81	
—	Chicago T1.8			34–88
W9MJL	Danville			22–82
WA9TEC	Decatur W2.2	146.34	449.60	
		449.60	146.90	
	W1.5	146.28	449.60	
		449.60	146.88	
WB9ADW	Genoa			13–76
WA9SGJ	Graymont			16–94
WA9EAT	Joliet	146.28	146.987	
WA9EAE	Oak Lawn CLOSED			
WB9AEF	Peoria			34–76
WA9EAM	Petersburg			34–94
W9FBS	Rockford			82–94
W9OGV	Rock Island T1.8			34–94
				34–76
W9YIY	Troy			16–76
WA9WVB	Urbana			34–76
WA9LIV	Waukeegan	145.95	146.55	
WB9HWS	Western Springs T2.0			04–64
K9CLW	Winnebago CLOSED			

INDIANA

WA9WVC	Anderson			22–82
W9ZPP	Evansville	52.92	52.575	
WA9EAU	Ft. Wayne			34–76
				34–94
				28–76
W9INX	Ft. Wayne			28–88
		52.68	53.88	
WA9HRK	Indianapolis			46–88
K9LEH	Indianapolis			34–76
K9JSI	La Porte			22–82
W9CSF	Michigan City T1.8 or PL			31–97
K9SJI	Muncie T1.7			34–76
WB9ADO	Schereville CLOSED			
W9EHZ	Schereville			34–91

IOWA

WAØVVA	Cedar Rapids T2.0			34–94
		146.34	445.52	
		445.52	146.94	
WAØVVD	Council Bluffs			22–82
KØIXR	Des Moines W1.2			34–94
WAØSNS	Waterloo			34–94

KANSAS

WAØAMR	Kansas City			34–94
		52.70	52.525	
KØOKI	Kansas City	52.88	52.525	
		448.10	449.10	

WA0VVW	Pittsburg			34–94
WA0CJQ	Salina			34–94
WA0SNP	Topeka			34–94
W0OKU	Wichita			34–94
W0IPB	Wichita			22–82

KENTUCKY

W4MOP	Louisville			34–94
WB4RYX	Louisville			46–88
K4UCS	Owensboro			34–94

LOUISIANA

WA5MZZ	Alexandria			34–94
WA5ZHD	Baton Rouge			34–94
W5WN	Lake Charles			34–94
WB5CDP	Monroe	52.827	52.525	
W5MLE	Morgan City			34–94
		440.00	146.94	
		444.50	52.525	
WB5AEG	New Orleans	444.20	449.20	
W5UK	New Orleans W1.8			34–94

MAINE

W1QXR	Bangor			34–94
WA1KGP	Sanford			13–73
WA1KGZ	Buckfield (Streaked Mt.)			34–94

MARYLAND

WA3OZO	Baltimore			22–82
				34–76
		448.10	449.10	
K3MOX	Baltimore	146.91	147.33	
WA3KWG	Cheverly			01–61
W3IJF	Frederick			13–73
WA3PPN	Havre de Grace			25–85
WA3BMM	Rockville	53.25	52.68	
		52.80	52.68	
K3SVA	Salisbury			22–82
WA3PJQ	Severn	146.46	147.06	
WA3CJD	Silver Spring	52.76	52.565	
WA3JCN	Silver Spring	448.00	449.00	
WA3PVO	Silver Spring			19–67
WA3PVP	Wheaton			07–67
		223.30	224.30	
		448.30	449.30	

MASSACHUSETTS

K1JMR	Boston	444.95	449.95	
WA1KEQ	Cape Cod			07–67
W1RGG	Fall River			28–88
W1VAK	Falmouth			34–94
K1AIU	Framingham			34–94
WA1KGR	Holyoke			34–94
W1QFD	Marlboro	147.03	147.87	
K1FFK	Mt. Greylock			31–91
		52.76	52.56	
K1AOI	Oxford TT			28–88
W1CSF	Pelham			13–73
W1BL	Princeton	53.345	50.50	
W1RJS	Salem			28–88
WA1MHN	Somerville			07–67
WA1KGS	Waltham			04–64
		444.05	449.05	
W1MTV	Westfield			10–70
W1HWK	Weston			22–82
WA1KRJ	Worcester			37–97

MICHIGAN

WB8CSC	Ann Arbor			37–97
WB8CSA	Benton Harbor T2.4			34–94
W8MAI	Benton Harbor			22–82
WA8BDO	Clarkston			31–85
WB8CQS	Detroit			34–76
WB8CRK	Detroit	449.00	444.00	
K8VLN	Detroit			46–64
WB8CRW	East Tawas			34–94
WA8PUD	Grand Rapids T2.4			34–94
K8TIW	Kalamazoo T2.1			34–94
WB8CQM	Lansing			34–94
K8WNJ	Muskegon			22–82
K8TJP	Trenton	437.90	442.90	
		433.70	432.90	
K8WKE	Utica			28–91

MINNESOTA

—	Duluth			34–94
K0RTU	Elk River T1.8			34–94
WA0SSN	Faribault			16–76
WA0JCX	Minneapolis			28–88
W0CKF	Minneapolis			94–46
		53.64	146.46	
		146.94	53.64	
W0PZT	Minneapolis			34–46
WA0CQG	Rochester			94–46
K0LAV	St. Paul W1.4			34–94
WA0NPZ	St. Paul	146.58	147.03	
K0PML	St. Paul			34–76
K0PMU	St. Paul T.18			16–76
W0UGR	Waseca			94–46
				34–94
WA0CJU	Waseca			34–94
—	Wilmar			34–94

MISSISSIPPI

K5TYP	Biloxi T2.0			34–94
WA5RMS	Gautier T2.4			34–94

MISSOURI

WA0AMR	Kansas City			16–76
K0FRA	Kansas City	52.70	52.525	
WA0TEG	Kansas City	52.88	52.525	
WA0VUN	Kansas City			22–82
WA0VVB	Kansas City			34–94
W0OKB	Savannah			10–94
WA0VVV	Springfield			34–94
WA0CJW	St. Louis			34–94
K0RWU	St. Louis	52.05	51.25	
		441.56	51.25	

MONTANA

W7YB	Bozeman			34–94
WA7KZF	Butte			34–94
		448.15	449.15	
WA7QAA	Great Falls			34–94

NEBRASKA

WA0MFC	Lincoln			34–94
K0YRL	N. Platte			34–94
W0EQU	Omaha			34–94

NEVADA

W7AKE	Las Vegas			20–80
		147.18	147.84	
		53.39	147.84	
	T			34–94
WA7HXO	Las Vegas			40–94
K7UGE	Las Vegas			34–94

W7CX	Reno	147.85	UHF	
		UHF	146.20	
WA7NHV	Reno			34–94
		147.00	146.94	
K7TNU	Reno	146.94	51.60	
		51.0	146.94	
K7UGT	Reno T2.4	146.94	147.48	
				34–94
K7VJZ	Reno	146.94	52.525	
		52.525	146.94	

NEW HAMPSHIRE

W1ALE	Concord			34–94
	Except 1st 3 min. of each 15:			
		146.46	146.94	
		146.46	52.525	
		52.525	146.94	
K1MNS	Derry			25–85
WA1KFV	Manchester CLOSED			
WA1KGO	Peterborough			19–79
WA1KGU	Salem			37–97

NEW JERSEY

W2KUU	Camden			25–85
W2BHK	Cherry Hill			22–82
K2IEZ	Fords	447.40	449.40	
WA2UWC	Greenbrook			34–94
				37–97
WB2KKO	Oakland			16–91
WA2UWR	Paramus PL 4A 141.3 Hz			19–79
		449.10	448.10	
K2GE	Sayerville			16–46
W2FLY	South Jersey			22–82
K2TYV/2	Split Rock			40–97
		444.9	449.9	
		146.4	449.9	
		444.9	146.97	
WA2ZVQ	Toms River			31–91
W2SJT	Washington			22–82
WA2PRI	W. Orange	443.25	448.25	
K2ODP	Woodbridge PL			22–82

NEW MEXICO

WA5KUI	Alamagordo			34–94
K5CQH	Albuquerque	146.46	147.06	
WA5JDZ	Albuquerque			34–94
WA5OIP	Albuquerque			25–88
WA5QXB	Albuquerque	146.40	147.00	
WA5QLZ	Albuquerque			28–88
	Las Cruces			34–94
		146.46	147.06	
W5PDO	Los Alamos			34–94
WA5YTG	Portales			34–94
WA5DMQ	Roswell			34–94
K5SFB	Sandia Crest	448.60	443.60	
WA5VKY	Sandia Crest	146.46	147.06	
WA5YTK	Sierra Blanca	145.50	146.50	

NEW YORK

W2DRZ	Bath			58–94
WA2CKW	Birch Hill	145.20	147.12	
K2LOT	Boston			31–91
				34–94
W2TFJ	Brookhaven	53.60	146.82	
		50.74	146.82	
K2KDA	Brooklyn	441.55	446.55	
WB2TLJ	Buffalo			31–91
		On request		34–94
WA2UYO	Cherry Creek			31–91
		146.34	146.147	
W2SB	Dunkirk			34–94
WA2UYI	Farmingdale LI	441.75	446.75	
WA2UYJ	Gore Mt.	441.15	446.15	
W3DEG	Grafton			22–76
K2KDA	Hemostead LI	441.70	446.70	
W2GHR	Hunter Mt.			28–88
				28–91
				28–85
WA2POJ	Huntington LI			25–85
WA2UZE	Huntington LI			52–76
WA2BXK	Hyde Park	441.00	446.00	
W2CXM	Ithaca			34–94
WA2UWK	Jamestown			34–94
				28–88
W2WJS	Long Island	441.65	446.65	
WA2UYP	Mt. Beacon	441.15	446.15	
W2OQI	Manorville LI T			34–82
		146.34	147.12	
WA2UVX	Millbrook	147.00	147.69	
WA2SUR	New York City			13–73
K2UHD	New York City	147.12	147.68	
WA2INM	New York City	146.205	146.805	
K2KDA	Plainview LI	441.80	446.80	
W2CVT	Poughkeepsie			37–97
		441.15	446.15	
WA2UWQ	Rochester			28–88
W2IBW	Rockland Cty CLOSED UHF			
K2AE	Schenectady			46–94
WA2YYQ	Staten Island			28–88
WA2YZZ	Staten Island RTTY	449.25	146.70	
WA2UWF	Syracuse			46–94
		53.75	52.64	
K2DHH	Troy	53.75	52.58	
WB2NNZ	Troy			34–94
		53.75	52.58	
K2GVI	Utica			34–94
WA2UWS	Utica			28–88
K2AVP	Westchester	146.46	147.06	
		(CO) 15		
		(CD)145.68	147.06	
WA2UYJ	Whiteface Mt.			22–82
K2LJC	Woodmere LI			04–64
WB2BLQ	Yonkers PL4A	31–91		

NORTH CAROLINA

WA4NUO	Asheville			34–94
WA4UMH	Beulaville			34–94
K4RSH	Chapel Hill			22–82
	Charlotte			16–76
W4BFB	Charlotte			34–94
WB4QFT	Durham	444.25	449.10	
K4RUQ	Durham W			34–94
WA4VTX	Elizabeth City			28–88
W4NBR	Goldsboro/Kinston			16–76
WB4OFF	Greensboro			16–76
K4VUG	High Point			34–94
W4PAR	Lexington			31–91
—	Mt. Airy			38–98
WB4NXE	McCain	52.525	146.05	
		52.78	52.525	
		146.42	52.525	
W4DCD	N. Wilkesboro	52.78	52.525	
		146.42	52.525	
		52.525	146.05	
WA4EHL	Raleigh	52.780	52.525	
		146.42	52.525	
		52.525	146.05	
K4ITL	Raleigh			28–88
WB4PPS	Roaring Gap			22–82
W4EXU	Salisbury			28–88
W4NYR	Shelby			28–88

NORTH DAKOTA

WAØVVZ	Eckman			34–94

OHIO

K8HRS	Ashtabula			34–76
WB8CRS	Cincinnati T1.8			34–94
W8AIC	Columbus			34–76
W8ERD	Columbus	29.50A	146.82F	
		50.54A	146.82F	

W8WTB	Columbus			34–76
WB8CQR	Cleveland PL			34–76
WB8CRV	Cleveland CLOSED			
WB8CQK	Dayton T			34–94
W8QLS	Delaware			37–97
		145.62	146.85	
W88CRL	Fletcher			46–88
WA8WMH	Hamilton			37–97
WA8PLZ	Miamisburg			22–82
	TT	448.60	146.82	
K8PWL	Miamisburg			22–88
WB8CRU	Newcomerstown			34–76
K8JHG	Ottawa			28–88
		52.76	52.525	
		53.36	53.54	
	W1.8	52.76	53.54	
K8ZPR	Steubenville			34–76
WB8CQQ	Toledo			34–76
—	Troy			46–88
W8IOO	Youngstown	Mobile		34–76
		Base		31–76

OKLAHOMA

—	Ardmore			34–94
WA5LDJ	Bartlesville			34–94
		52.525	146.94	
—	Cherokee	146.94F	145.96A	
WA5MQA	Chickasha			34–94
				37–97
		449.45	444.45	
WA5YUH	Durant			34–94
WA5QYE	Enid			34–94
		449.00	447.00	
K5CEM	Oklahoma City			22–82
WA5YTI	Oklahoma City			34–94
WA5ZZA	Oklahoma City			16–76
—	Ponca City			34–94
WA5LVT	Tulsa			34–94
				28–88
		52.68	52.525	
		449.10	444.10	
WA5SJE	Tulsa			22–82

OREGON

W7DBS	Eugene			34–94
—	King Mt.			34–94
—	LaGrande			34–76
W7FIO	Lookout Mt.			34–94
		52.92	53.46	
—	Mary's Peak T2.25			34–94
W7OFY	Medford T2.4			34–94
—	Newport			76–94
—	Pendleton			34–94
K7DVK	Portland	447.17	449.17	
K7SJQ	Portland	444.17	449.17	
W7VS	Portland T2.1			34–94

PENNSYLVANIA

W3OI	Allentown			34–94
WA3IGS	Berwyn			28–76
		52.80	52.72	
W3OK	Bethlehem			16–70
W3VV	Bradford			34–94
				25–85
K3ZTP	Coatsville			22–82
K3DSM	Devon 445.90	448.90		
WA3KUV	Erie			19–79
WA3MOP	Erie	449.55	444.55	
WA3ICC	Harrisburg			34–76
WA3KWI	Philadelphia	449.00	444.00	
W3QV	Philadelphia AM	29.64	29.493	
W3SK	Philadelphia			37–97
K3GKB	Honeybrook			13–73
WA3BKO	Philadelphia			28–88
				16–76
				34–94
				34–76
		446.60	449.60	
WA3KUR	Philadelphia			31–91
		52.72	52.64	
		52.76	52.60	
		448.80	443.80	
WA3QCE	Pittsburgh			34–76
W3BN	Reading	52.575	52.680	
W3CCH	Reading	51.575	52.64	
—	Scranton			34–94
WA3IPP	Sellersville			28–76
				34–76
		446.50	449.50	
WA3KUW	State College			34–76
K3PQZ	York			34–76

RHODE ISLAND

K1OHE	Bristol	34–94
K1ABR	Providence	10–70
W1HQV	Woonsocket	16–76

SOUTH CAROLINA

WB4QGK	Charleston TT1447 Hz			
WA4MPC	Columbia			28–88
WB4PLN	Columbia			34–94
		52.76	52.525	
WB4PUP	Greenville			28–88
				34–94
		52.76	52.525	
WA4SSJ	Greenville	52.76	52.525	

SOUTH DAKOTA

W0BXO	Brookings T2.1	34–94
WA0VVG	Sioux Falls T1.8	34–94

TENNESSEE

WB4KLO	Chattanooga			34–94
K4HXD	Knoxville			34–94
				38–94
		146.34	440.60	
		146.38	440.60	
K4RSV	Lenoir City	146.46	147.06	
W4BS	Memphis			22–76
		440.00	449.00	
W4CV	Memphis			34–94
W4AY	Nashville			10–64
WB4QEY	Nashville	146.04	147.18	
W4RFR	Nashville			34–94
WA4YNO	Nashville	146.70	147.70	
—	Oak Ridge			28–88
W4IWV	Shelbyville			34–94

TEXAS

—	Abilene			34–94
—	Alice	444.10	449.10	
W5CBT	Amarillo			34–94
K5FOG	Arlington	53.05	53.15	
		UHF		
W5NEC	Austin			34–94
WA5YTO	Austin	449.10	444.10	
W5AW	Big Spring			34–94
WA5YTJ	Corpus Christi			34–94
WA5HNW	Dallas	53.55	52.95	

WA5VKV	Dallas	449.00	444.00	
WA5VKW	Dallas			28–88
W5HHS	Denton			25–85
WA5MWI	Ft. Smith			34–94
K5DSV	Ft. Worth	53.325	53.725	
WA5KTO	Ft. Worth			16–76
		448.90	443.90	
WA5YTM	Ft. Worth			34–94
—	Ft. Worth	53.05	53.15	
WA5QLA	Houston			28–88
WA5QTZ	Houston			22–82
WA5YUB	Houston			16–76
WA5YTY	Killeen			34–94
WA5YUP	Longview			28–88
WB5BRY	Lubbock			34–94
W5QGG	Midland			34–94
WA5SNJ	Pasadena			34–94
		441.10	449.10	
W5YNL	Plainview			22–82
				22–94
WA5YUS	Port Arthur			34–94
W5UFO	San Angelo			34–94
WA5UNH	San Antonio	52.88	52.525	
WA5VKZ	San Antonio			34–94
		UHF		
WA5LOL	Tyler			34–94

UTAH

WA7GTU	Cedar City			34–94
WA7AKI	Salt Lake City			34–94
		444.90	449.90	

VERMONT

WA1KGM	Mt. Ascutney			16–76
W1ABI	Killington			28–88
		441.20	446.20	
W1KOO	Mt. Mansfield			34–94
		444.40	449.40	

VIRGINIA

WB4QFP	Arlington			31–91
WB4KNX	Charlottesville			28–88
K4QQS	Chesapeake			22–76
WB4QEP	Danville			28–88
WB4KNU	Hampton			34–94
W4GCE	Lynchburg	146.22	147.42	
WB4HCX	Lynchburg			34–94
WB4DRI	Manassas	52.78	52.525	
WB4URR	Manassas W2.5	37–97		
WB4KNN	Newport News			34–94
W4DXC	Richmond	52.72	52.640	
W4NJE	Richmond	146.22	147.42	
		146.22	52.64	
		52.64	147.42	
W64QEO	Richmond W1.4			34–94
WA4VOS	Richmond			28–88

WASHINGTON

WA7KGV	Bawfaw Mt. T1.95			34–94
WA7KZG	Chehalis T1.95			34–94
—	Ephrata			34–94
W7DAQ	Longview	53.29	146.76	
		146.76	53.29	
—	Moses Lake			34–94
W7QKL	Mt. Rainier			34–76
				34–94
WA7KYY	Mt. Spokane			34–94
K7IUT	Olympic	52.525	53.29	
W7FHZ	Puget Sound CLOSED			
K7PBU	Puget Sound	449.85	444.85	
W7DXX	Rattlesnake Mt.			34–58
W7DBF	Seattle CLOSED			
K7GMR	Seattle	52.525	53.29	
W7PUG	Seattle			88–58
K7L8V	Spokane	52.525	53.29	
K7PYC	Tumwater	52.525	53.29	
WA7AJF	Vancouver	52.92	53.46	
—	Wenatchee			34–94
—	Yakima			34–94

WEST VIRGINIA

WB8ARY	Huntington	34–76
K8SXO	Huntington	34–76
K8BOT	Parkersburg	34–76
K8ZPR	Weirton	34–76
W8JDJ	Wheeling	34–76

WISCONSIN

WA9ZEF	Appleton T1.8	34–76
W9AYR	Green Bay	28–88
WA9PBW	Madison T2.1	34–76
WA9WVE	Madison T2.0	46–88
W9ROM	Milwaukee T	34–94
W9AIQ	Sturgeon Bay T1.8	34–76
WA9LIV	Waukegan	34–76

WYOMING

K7KMT	Casper			34–94
		444.55	449.55	
WA7OTP	Casper			34–94
WA7KZC	Laramie			16–76
		444.30	449.30	
WA7EGK	Laramie			34–94
				76–94
K7SDD	Laramie			16–76
W7RPV	Worland			34–94

CANADA

ALBERTA

VE6AUY	Calgary			34–94
VE6WQ	Edmonton	146.46	147.00	
VE6WO	Edmonton	146.46	147.33	
VE6OL	Grand Prairie	146.46	147.00	
—	Lethbridge			34–94
—	Red Deer	146.46	147.00	

BRITISH COLUMBIA

VE7ELK	Chilliwick	146.46	147.00	
		147.33	146.58	
—	Kamloops			34–94
VE7CAP	Kimberly			34–94
VE7BTU	Nelson	146.46	147.33	
—	Penticton			34–94
VE7AFG	Prince George	146.58	147.33	

VE7CAQ	Trail			34–94
VE7RPT	Vancouver			34–94
VE7BUZ	Vancouver			34–94
VE7ACS	Vancouver	147.33	146.58	
VE7BEL	Victoria	146.22	147.54	

MANITOBA

VE4XK	Winnepeg			46–94

NEW BRUNSWICK

VE1PD	Crabbe Mt.	147.80A	144.225A	
VE1VHF	Moncton			46–94
VE1KI	St. John			46–94

NEWFOUNDLAND

VO1GT	St. John's			46–94

NOVA SCOTIA

VE1ARC	Halifax			46–94
VE1JD	Sydney			46–94
VE1XK	Truro			46–94

ONTARIO

VE3KBR	Belleville			46–94
VE3KCR	Chatham			34–94
VE3LCR	Grimsby	146.49	147.09	
VE3DRW	Hamilton			16–76
VE3KER	Kingston	146.34	147.06	
VE3LAC	London	146.46	147.06	
VE3KSR	Kitchener			34–94
				37–97
VE3OSH	Oshawa	146.40	147.12	
VE3CRA	Ottawa			46–94
		443.30	448.30	
VE3PBO	Peterborough			34–94
VE3BER	Pt. Colborne FAX, RTTY		449.40 146.70	
VE3STP	Renfrew	146.34	147.06	
VE3NRS	St. Catherines	146.22	147.24	
VE3SAR	Sarnia			34–94
VE3SSM	Sault Ste. Marie			34–94
VE3SRS	Sudbury			46–94
VE3RPT	Toronto	146.46	147.06	
VE3MOT	Toronto	146.58	147.18	
VE3SIX	Toronto	52.760	52.525	
—	Windsor	146.40	147.06	

QUEBEC

VE2CRS	Chicoutimi			46–94
VE2UV	Granby	146.58	147.54	
VE2PY	Laval			28–88
VE2CSL	Matane			46–94
VE2ASU	Mont Buckland	146.70	147.60	
VE2SP	Mont Jim Gray			46–94
VE2TA	Mont Orford	146.52	147.50	
VE2RM	Mont Rigaud	146.40	147.18	
		444.00	449.00	
VE2XW	Mont St. Bruno	146.70	147.60	
VE2CAT	Montreal			18–64
VE2CLA	Montreal	146. 10	147.30	
VE2OM	Quebec			46–94
VE2VD	Quebec	146.52	147.50	
VE2NY	Riviere-du-Loup			46–94
VE2MT	Shawbridge	146.46	147.06	
VE2SS	Sherbrooke			46–94
VE2CTM	Thetford Mines	146.34	147.40	
VE2AT	Trois Rivieres			46–94

SASKATCHEWAN

VE5SS	Regina	146.46	147.33	
VE5SK	Saskatoon			46–94

FOREIGN

AUSTRIA

OE5XGL	Altmuenster	144.15	145.75
OE7XTI	Innsbruck	144.15	145.75
OE5XUL	St. Johann	144.15	145.75

DENMARK

- -	Copenhagen T1.4&2.2	145.35	145.85
OZ8JS	Hadersley	145.35	145.85

GERMANY

DBØWA	Aachen	144.20	145.80
DBØXA	Altenwalde	144.30	145.70
- -	Audernach-Mayen	144.25	145.85
DBØZA	Aschberg	144.25	145.85
- -	Bad Koenig	144.175	145.775
DBØXB	Baederstrasse (Baltic Sea)	144.20	145.80
- -	Bamberg	144.20	145.80
DLØJMA	Bayreuth	144.15	145.85
- -	Bentheim-Lingen	144.20	145.80
DLØSB	Berlin	145.15	145.60
DBØWF	Berlin	144.15	145.75
- -	Bocksberg (Harz)	144.175	145.775
DLØBGA	Braunschweig	144.80	145.89
- -	Bremen	144.25	145.85
DBØWC	Bremerhaven	144.20	145.80
- -	Cham	144.15	145.75
- -	Coburg	144.15	145.75
DJ9CRA	Coxhafen	144.15	145.85
- -	Darmstadt	144.20	145.80
- -	Deggendorf	144.20	145.80
DBØWD	Deisier	144.20	145.80
DBØWT	Detmold	144.25	145.85
DBØZR	Dortmund	144.20	145.80
DBØXR	Dreilaendereck (Loerrach)	144.20	145.80
DBØWN	Duisburg	144.15	145.75
- -	Elm Mountain	144.80	145.90
DBØWE	Essen	144.25	145.85
- -	Feldberg (Rhein-Main)	144.15	145.75
- -	Frankfurt	431.05	438.92
DKØRM	Frankfurt	144.15	145.85
- -	Giessen	431.20	438.80
DBØWG	Goeppingen	144.175	145.775
DBØWS	Goslar-Steinberg	144.25	145.85
DBØZZ	Grab	144.20	145.80
DBØXG	Greding	144.20	145.80
DBØXH	Hamburg	144.15	145.75
DBØWH	Hannover	144.15	144.75
DBØZH	Heidelberg	144.25	145.85
- -	Hersefeld	144.20	145.80
DBØYH	Hoechenschwand (Black Forest)	144.25	145.85
DBØWV	Hoechsten	144.25	145.85
- -	Hoher Meissner	144.225	145.825
DBØYK	Homberg-Kaiserslauten	144.20	145.80
DBØZF	Kaiserstuhl (Freiburg)	144.15	145.75
- -	Kalmit	144.30	145.70
- -	Kassel	144.15	145.75

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- -	Koblenz	144.20	145.80
- -	Koeln-Bergheim	144.25	145.85
DBØWK	Koustanz	144.15	145.75
- -	Knuell	144.25	145.85
DBØWL	Lahr	144.15	145.75
- -	Leer/Ostfriesland	144.20	145.80
DJ3JWA	Lindau-Hertz	144.15	145.85
- -	Lindau-Northeim (Hannover)	144.20	145.80
DLØBLB	Ludwigsburg	144.85	145.30
DBØYY	Ludwigsburg	144.30	145.70
DBØZL	Luechow/Elbe	144.20	145.80
DBØXS	Merzig/Saar	144.25	145.85
DBØZM	Munich	144.15	145.75
DBØWM	Muenster/Westf.	144.25	145.85
DBØZN	Neuersberg	144.15	145.75
DLØNFA	Nurnberg	144.15	145.85
DBØZB	Ochsenkopf	144.25	145.85
DBØWN	Ochsenwang	144.225	145.825
DBØZO	Osnabruck	144.15	145.75
DLØZR	Schwerte	145.15	145.90
DBØWS	Siegen	144.20	145.80
DBØWR	Stuttgart	144.15	145.75
DBØWX	Triberg	144.20	145.80
DBØZW	Weiden	144.20	145.80
DBØWB	Winterberg	144.15	145.75
DBØWZ	Wurzburg	144.25	145.85
DBØZU	Zugspitze	144.275	145.725

NEW ZEALAND

New Zealand has been working on a 2 meter band plan for the country, with provision for all modes of operation.There are FM simplex channels every 50 kHz from 145.8 to 146.2 MHz, with 145.85, 146.0 and 146.15 MHz, as the prime channels. 146.0 MHz to be first. On the FM repeater side they have allocated four channels on 700 kHz spacing. A pity, as it does not make them compatible to Australia. Inputs on 146.3, .35, .4 and .45 with the outputs on 145.6, .65, .7 and .75. The three-channel AM repeater systems have inputs on 144.6, .65 and .7 with the outputs on 145.725, .775 and .825. 144.8 MHz is set aside as an RTTY net frequency. The beacons are on the "hundred" equal to the call area, e.g. ZL1 on 145.1, ZL2 on 145.2, ZL3 on 145.3, and ZL4 on 145.4 MHz. The segment 144.0 to 144.1 MHz is set aside as DX and experimental working. 144.1 to 144.5 MHz is a general working segment.

SWEDEN

SKØDZ	Stockholm T2.172	144.90	145.80
- -	Rommeleasen T2.172	144.90	145.80

SWITZERLAND

- -	Appenzell T1.595	431.20	438.80
- -	Fribourg T1.29	431.05	438.92
- -	Luzern T1.16	431.20	438.80
- -	Luzern T1.595	431.05	438.92
- -	Solothurn T1.16	431.20	438.80
- -	Zurich T1.16	431.05	438.92

ELECTRONIC SYMBOLS

ANTENNA



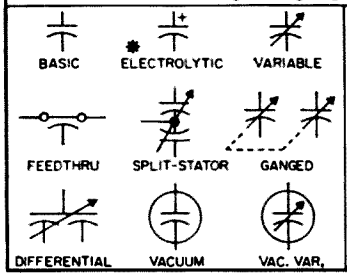
NORMALLY USED IN BLOCK DIAGRAMS, BUT MAY BE USED IN ANY SCHEMATIC WHERE ANTENNA IS CONNECTED DIRECTLY TO CIRCUIT WITHOUT BENEFIT OF RF CONNECTOR

BATTERY



DO NOT FORGET TO INDICATE VOLTAGE AND POLARITY

CAPACITORS



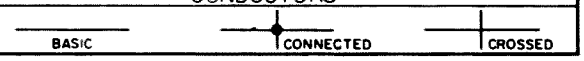
NOTE THAT CURVED PORTION OF SYMBOL ALWAYS DESIGNATES OUTSIDE FOIL OF FIXED CAPACITORS (EXCEPT ELECTROLYTICS, WHERE IT INDICATES THE NEGATIVE TERMINAL)

THE CURVED PORTION IN THE CASE OF A VARIABLE WILL INDICATE THE MOVABLE PART

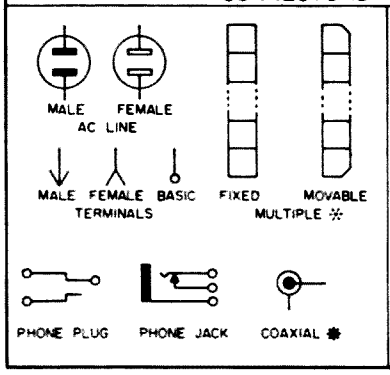
* INDICATE POLARITY, AND VALUE IN μF

WHEN OTHER THAN ELECTROLYTIC, VALUES ARE ASSUMED TO BE pF WHEN 1 OR GREATER, AND μF WHEN LESS THAN 1

CONDUCTORS



CONNECTORS



SHOULD NONE OF THE SYMBOLS DESCRIBED HERE SEEM TO MATCH YOUR SITUATION, DESCRIBE THE CONNECTOR AND/OR LIST THE MANUFACTURER'S PART NUMBER

* FOR ANY COAXIAL-TYPE CONNECTOR, SUCH AS RF, MICROPHONE, PHONO, ETC.

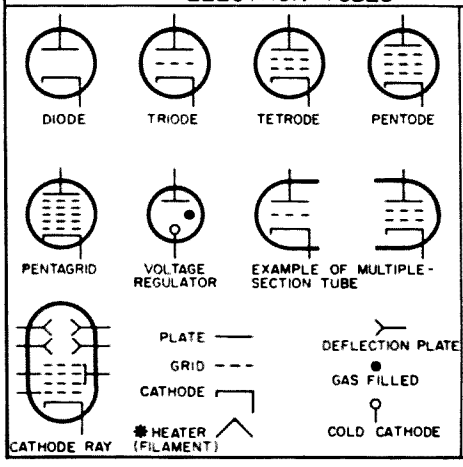
※ NUMBER THE BLOCKS TO CORRESPOND TO TERMINAL MARKINGS, WHEN APPROPRIATE

CRYSTAL



ALWAYS INDICATE CRYSTAL FREQUENCY (IN kHz, MHz, ETC.)

ELECTRON TUBES

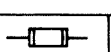


ALWAYS LABEL ELEMENTS WITH TUBE PIN NUMBERS

REFER TO TUBE MANUAL FOR DATA ON INDIVIDUAL TUBE TYPES

* FILAMENTS OR HEATERS (WITH THE EXCEPTION OF DIRECTLY-HEATED CATHODES) SHOULD BE SHOWN EXTERNAL TO TUBE CIRCLE, AND PREFERABLY IN THE POWER SUPPLY

FUSE



INDICATE CURRENT, VOLTAGE RATINGS, AND SLO-BLO, ETC., AS APPROPRIATE

GROUND CONNECTIONS



CHASSIS GROUND SYMBOL IS NORMALLY THE ONLY TYPE USED IN SCHEMATICS

EACH GROUNDED CIRCUIT COMPONENT WILL BE SHOWN CONNECTED TO AN *INDIVIDUAL* CHASSIS GROUND, UNLESS A COMMON GROUND BUS IS ESSENTIAL TO PROPER CIRCUIT OPERATION

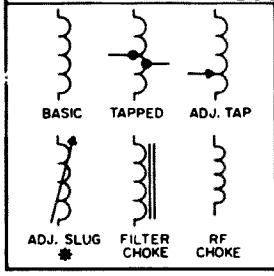
HEADSET



NORMALLY USED IN BLOCK DIAGRAMS, BUT MAY BE USED IN ANY SCHEMATIC WHERE CONNECTED DIRECTLY INTO CIRCUIT WITHOUT PHONE PLUG

INDICATE IMPEDANCE IF VALUE IS CRITICAL

INDUCTORS



INCLUDE ALL NECESSARY DATA INCLUDING ANY OF FOLLOWING INFORMATION WHICH IS APPLICABLE:

- WIRE SIZE & TYPE
- COIL OR FORM O.D. OR I.D.
- NUMBER OF TURNS AND/OR LENGTH
- MANUFACTURERS PART NUMBER
- TAP POSITION ABOVE COLD END

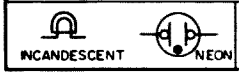
* FERRITE CORE WILL BE ASSUMED UNLESS BRASS IS SPECIFIED. INDICATE TYPE OF FERRITE, IF CRITICAL

KEYS



* BE SURE TO DESIGNATE "DIT" & "DAH" CONTACTS

LAMPS



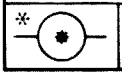
INDICATE MANUFACTURER'S PART NUMBER AND/OR VOLTAGE & CURRENT RATING

LOUDSPEAKER



INDICATE VOICE COIL IMPEDANCE & POWER RATING, ETC., WHEN CRITICAL

METERS



* INDICATE TYPE OF METER HERE (μA, mA, V, ETC.)
※ INDICATE SCALE RANGE HERE (0-1, 0-50, ETC.)
DON'T FORGET TO INDICATE PROPER POLARITY

MICROPHONE



NORMALLY USED IN BLOCK DIAGRAMS BUT MAY BE USED IN SCHEMATIC WHEN WIRED DIRECTLY INTO CIRCUIT WITHOUT CONNECTOR

INDICATE TYPE (CARBON, XTAL, ETC.)

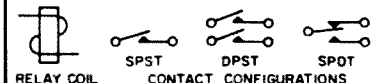
MOTOR



LABEL AS MOTOR, FAN MOTOR, ETC.

INDICATE OPERATING VOLTAGE & CURRENT AND/OR MANUFACTURER'S PART NUMBER

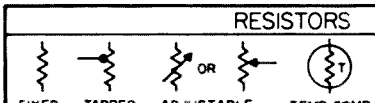
RELAYS



SPECIFY COIL VOLTAGE, RESISTANCE, ETC., AND/OR MANUFACTURER'S PART NUMBER

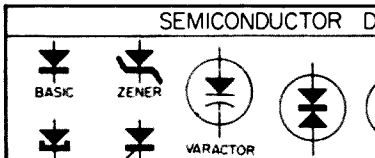
CONTACT CONFIGURATIONS SHOWN ARE BASIC AND MAY BE EXPANDED

RESISTORS



INDICATE VALUE, IN OHMS(Ω), KILOHMS(K), OR MEGOHMS(M), AND/OR MANUFACTURER'S PART NUMBER.
1/2W 10% IS ASSUMED UNLESS OTHERWISE NOTED

SEMICONDUCTOR DIODES



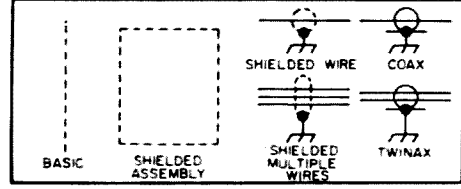
INDICATE MANUFACTURER'S PART NUMBER AND/OR APPROPRIATE RATINGS

REFER TO MANUALS FOR SYMBOLS NOT SHOWN

S INDICATES SILICON
G " GERMANIUM

ELECTRONIC SYMBOLS

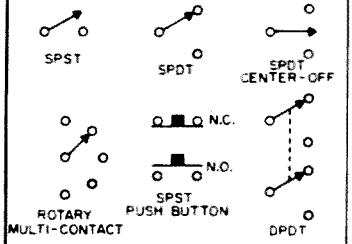
SHIELDING



SHIELDS ARE ASSUMED TO BE GROUNDED UNLESS OTHERWISE NOTED

INDICATE IF SHIELD ON CONDUCTOR IS TO BE GROUNDED ONE END ONLY, & SPECIFY WHICH END

SWITCHES



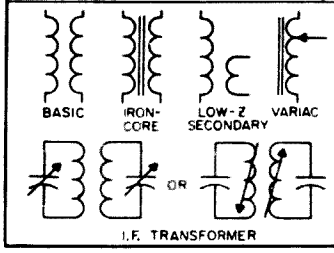
ONLY BASIC CONFIGURATIONS ARE SHOWN. COMBINE OR EXPAND AS NECESSARY TO SUIT

SELF-HOLDING SWITCH OPERATION IS ASSUMED UNLESS SPRING-RETURN IS SPECIFIED

NON-SHORTING TYPE IS ASSUMED UNLESS SHORTING TYPE IS SPECIFIED

SWITCH SECTIONS WHICH ARE SIMULTANEOUSLY OPERATED OR GANGED SHOULD BE JOINED WITH A DOTTED LINE

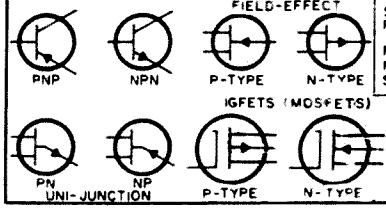
TRANSFORMERS



SHOW (4) LOOPS EACH WINDING EXCEPT (6) LOOPS ON HIGH-VOLTAGE SECONDARIES AND (2) ON FILAMENT WINDINGS AND NON-RESONANT LOW-Z RF COUPLING LINKS

TRANSFORMER DESCRIPTION SHOULD INCLUDE MANUFACTURER'S PART NUMBER AND RATINGS, OR CONSTRUCTION DATA

TRANSISTORS



SPECIFY MANUFACTURER'S PART NUMBER OR RATINGS

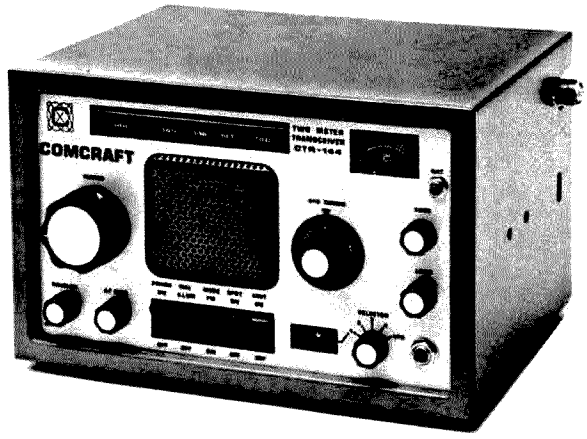
REFER TO TRANSISTOR MANUALS FOR TYPES NOT SHOWN HERE.

ELECTRONIC ABBREVIATIONS

(AS USED ON DRAWINGS AND SCHEMATICS)

NOMENCLATURE	ABBREVIATION(S)
ALTERNATING CURRENT	AC
AMPERE	A
AMPLIFIER	AMP
AMPLITUDE MODULATION	AM
ANTENNA	ANT
AUDIO FREQUENCY	AF
AUTOMATIC FREQUENCY CONTROL	AFC
AUTOMATIC GAIN CONTROL	AGC
AUTOMATIC VOLUME CONTROL	AVC
BATTERY	B
BEAT FREQUENCY OSCILLATOR	BFO
BROADCAST	BC
CAPACITANCE, CAPACITOR	C
CONTINUOUS WAVE	CW
CRYSTAL	X, XTAL
CURRENT	I
DECIBEL	dB
DIODE, SEMICONDUCTOR (ALL TYPES)	D
DIRECT CURRENT	DC
DOUBLE COTTON COVERED	D.C.C.
DOUBLE POLE DOUBLE THROW	DPDT
DOUBLE POLE SINGLE THROW	DPST
DOUBLE SILK COVERED	D.S.C
ELECTRON TUBE (ALL TYPES)	V
ENAMEL COVERED	ENAM
FILAMENT	FIL
FREQUENCY	FREQ. f
FREQUENCY MODULATION	FM
FUSE	F
GROUND	GND
HENRY	H
HERTZ (CYCLES PER SECOND)	Hz
IMPEDANCE	Z
INDUCTANCE, INDUCTOR	L
INSIDE DIAMETER	I.D.
INTERMEDIATE FREQUENCY	I.F
JACK	J
KILOHERTZ (KILOCYCLES PER SECOND)	kHz
KILOHM	k, kΩ
KILOVOLT	kV
KILOWATT	kW
LAMP	I
LOUDSPEAKER	SPKR
MEGAHERTZ (MEGACYCLES PER SECOND)	MHz
MEGOHM	M, MΩ
METER	M
MICROAMPERE	μA
MICROFARAD	μF
MICROHENRY	μH

NOMENCLATURE	ABBREVIATION(S)
MICROPHONE	MIC
MICROVOLT	μV
MICROWATT	μW
MILLIAMPERE	mA
MILLIHENRY	mH
MILLIVOLT	mV
MILLIWATT	mW
NEGATIVE (POLARITY)	-, NEG
NORMALLY CLOSED	NC
NORMALLY OPEN	NO
OHM	Ω
OSCILLATOR	OSC
OUTSIDE DIAMETER	O.D.
PICOFARAD	pF
PLUG	P
POSITIVE (POLARITY)	+, POS
POWER AMPLIFIER	PA
PRIMARY	PRI
PUSHBUTTON	PB
RADIO FREQUENCY	RF
RADIO FREQUENCY CHOKE	RFC
RECEIVE	REC
RECEIVER	RCVR
RELAY	K
RESISTANCE, RESISTOR (ALL TYPES)	R
ROOT MEAN SQUARE	RMS
SECONDARY	SEC
SHORTWAVE	SW
SINGLE COTTON COVERED	S.C.C.
SINGLE POLE DOUBLE THROW	SPDT
SINGLE POLE SINGLE THROW	SPST
SINGLE SILK COVERED	S.S.C
SWITCH	S
TIME	t
TRANSFORMER	XFMR, T
TRANSISTOR (ALL TYPES)	Q
TRANSMIT	XMIT
TRANSMITTER	XMTR
ULTRA HIGH FREQUENCY	UHF
VACUUM TUBE VOLTMETER	VTVM
VERY HIGH FREQUENCY	VHF
VOLT OHM METER	VOM
VOLT, VOLTS	V
VOLTAGE	E
WATT	W
WAVELENGTH	λ



TESTING THE COMCRAFT CTR-144

Can an FM nut live comfortably with a tunable receiver and a vfc transmitter?

As an old time two meter addict my hands began to shake with anticipation as I plugged in the new Comcraft transceiver, just looking forward to being able to tune the receiver dial and get back to the old familiar concept of frequency being marks on a slide rule dial instead of numbers on a switch.

Sure enough, as I tuned from 146.5 to 147.0 there were all the repeaters, blasting through. And even though this segment of the two meter band takes up only about 3/8" of the dial, I still could identify most of the repeater channels by their position on the dial. The receiver was quite sensitive and I was able to hear repeaters right on down to New Haven, some 150 miles or so away.

The most exciting discovery was that "secret" repeater up in Manchester (NH) up above 147 MHz. I knew their input frequency, but had not been able to get them to spill the beans on the output so I could get crystals and their promises of getting crystals for me had been dragging on for a couple of years, so when I tuned across the repeater output I let out a whoop and zeroed in the Comcraft vfo and called in. There was a stunned moment of silence and then they acknowledged me. I didn't tell them how I found them.

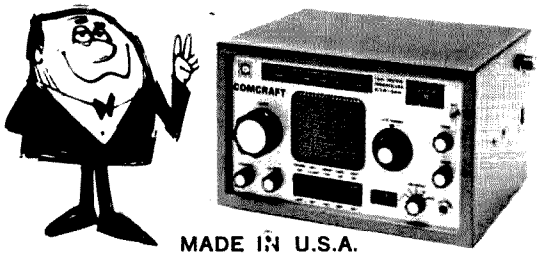
The vfo is stable enough to work through FM repeaters with no problem. My counter shows it to hit within 25 Hz or so each time it is keyed! There are three internal crystal positions plus a front panel jack for a fourth crystal position. The rig uses the very popular 8 MHz FT-243 type crystals, which are still around by the thousands from WW II.

The CTR-144 is basically an up-to-date solid state Communicator. It tunes from 144–148, with enough overlap to bring joy to the MARS and CAP enthusiasts. My unit tuned from 144.00 to 148.15 on both receiver and vfo, but this could be easily changed enough to add or subtract a half MHz or so by touching the band-setting capacitors.

The power supply is built in for 117V ac operation, plus the usual 12V dc power cord for mobile use. A little battery test button on the front panel lets you check the battery condition. This test button may not be of great interest for mobile applications, but if the unit is used in conjunction with the accessory CBP-12 Comcraft battery pack, it will tell you how things are going. This battery pack is automatically recharged by the ac supply, by the way.

2 Rigs in one!

THE COMCRAFT CTR-144



MADE IN U.S.A.

The First AM-FM Solid-State Transceiver For Two Meters

No longer is it necessary to choose between AM and FM on two meters. Now you can have both in one compact unit. Join the gang on the new FM repeaters yet still be able to "rag chew" with old friends either AM or FM anywhere in the two meter band.

COMPARE THESE FEATURES

TRANSMITTER:

- Built-in VFO (Frequency converted for stability)
- AM and FM both crystal and VFO
- Four transmit crystal positions (8 MHz)
- 12 watt input AM and FM
- High level transmitter modulation on AM
- Bandpass coupled transmitter requiring only final tune and load
- Three internal transmit crystal sockets with trimmers for netting
- One transmitter crystal socket on the front panel
- Deviation limiting
- 146.94 MHz crystal included

RECEIVER:

- Double conversion
- Crystal controlled first conversion
- MOS FET receiver front-end
- Integrated circuit limiter and discriminator for FM
- Envelope detector and series gate noise clipper for AM
- Built-in squelch for both AM and FM

GENERAL:

- Separate transmitter and receiver tuning
- Built-in 115VAC power supply
- Direct 12VDC operation for mobile or portable operation
- Optional portable rechargeable snap-on battery pack available
- "S" Meter also used for transmitter tune up
- Military style glass epoxy circuit boards
- Anodized lettering and front panel
- Baked epoxy finish on the cabinet
- 47 transistors, 22 diodes, 1 integrated circuit
- Dimensions: 10¼"W x 6¼"H x 7½"D

Warranty—90 Days Parts and Labor

The CTR-144 is available at your DEALER

$459.95

COMCRAFT COMPANY
P.O. BOX 266—GOLETA, CALIF. 93017

Write for more information or use READER SERVICE

The receiver gets its selectivity and rejection of images by a clever system of i-f management. The first local oscillator is at 65 MHz and is crystal controlled. This doubles to 130 and the output is in the 14–18 MHz range which is tuned by the first i-f. The second local oscillator drops the i-f to 2 MHz and then the signal is channeled into either an FM or AM detector.

The 65 MHz oscillator is used by the transmitter to beat the 7–9 MHz vfo up to 72–74 MHz. This is then doubled to the output frequency.

While I find a counter quite helpful in putting the CTR exactly on a repeater input frequency, I have had little trouble zeroing in just by listening for the repeater squelch-tail and tickling the vfo dial until I hit the pass-band. While visiting New York I cut a 19" length of coathanger and stuck it into the antenna conductor, zipped onto WA2SUR's input on 146.19 and found myself talking with a number of old friends. This was from my livingroom in Brooklyn about five miles away!

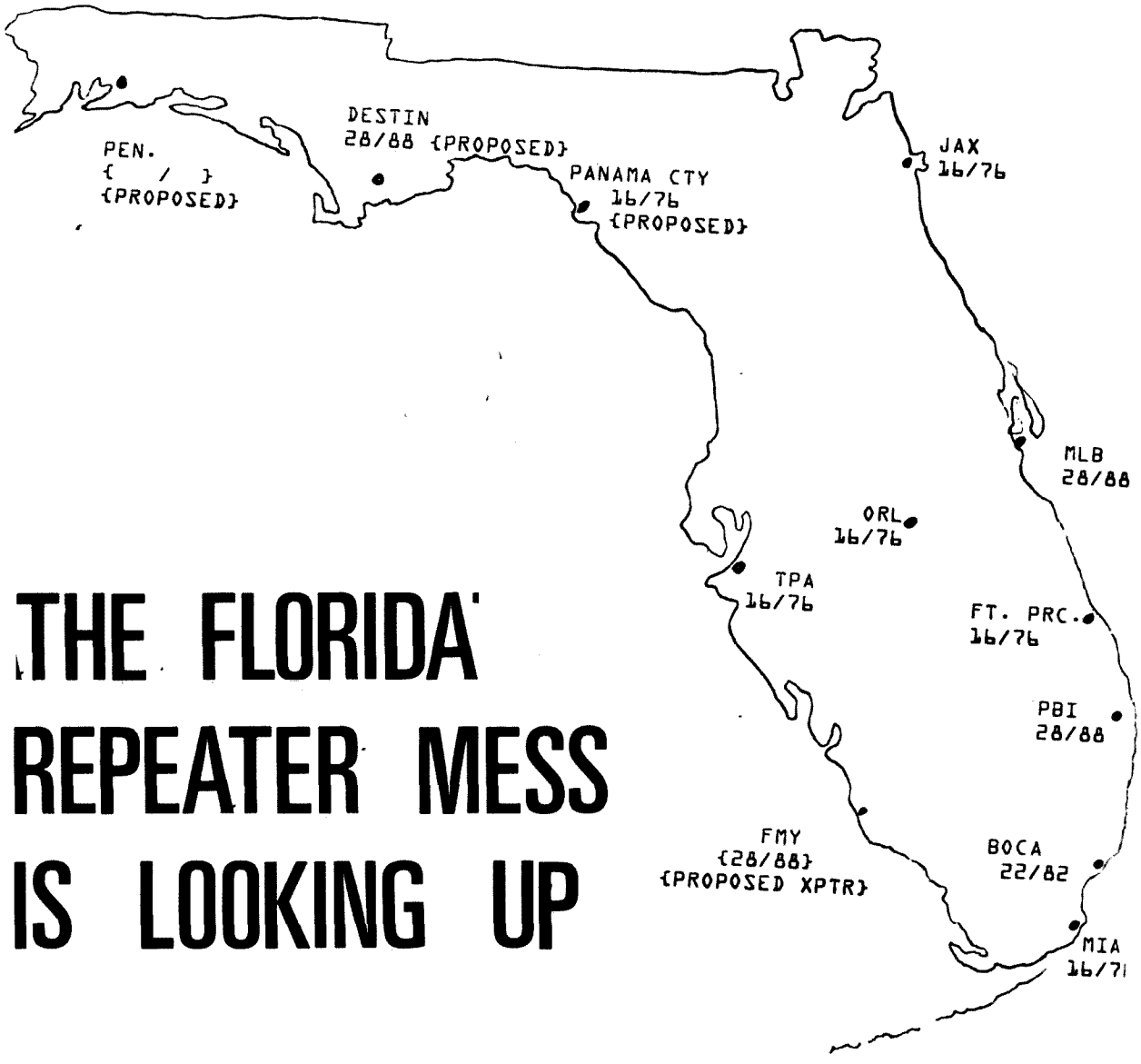
While I appreciate the benefits of channelized operation as much as anyone, I do have to admit that I like it a lot that I can now tune the 144 MHz band complete and check to see what is going on. And who can afford all the crystals it takes to get all of the repeaters? With new repeaters coming on the air by the week, who can keep up with it? I'd be ordering more crystals every week and, at $4 to $6 each, this is a luxury beyond the means of a mere magazine editor.

One thing I did learn from being able to tune the entire 144 MHz band . . . the FM activity is just about the only activity that I'm going to hear up this way. I may be able to get into seventeen FM repeaters from my home, but I have heard one and only one AM signal on the band in several weeks of listening. I haven't had a good chance to tune the entire band since my NC-300 receivers were swiped a few years ago. The band sure has changed!

The Comcraft CTR-144 may not meet the demands of the purist FM old timer, but it sure does do its job well and is a lot of fun. And it will run AM if you need it!

. . .W2NSD/1

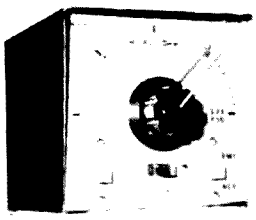
THE FLORIDA REPEATER MESS IS LOOKING UP



Jeffrey R. Harrow WA4RLG
1336 S. Biscayne Pt. Rd.
Miami Beach FL 33141

I'm not all that old (22) and yet, as I look back about six years it seems an immensely long time ago that Glynn WA4LHK, Bill WA4MKD, myself, and the rest of the renowned N.O.M.A.R.C. group put on (to my knowledge) the first amateur two meter repeater in Florida. It consisted of a preprog. G.E. into two ground planes up about five stories – and we were ecstatic with a one to two mile range.

Well, as you can see from the sketch, Florida took to two meters with a vengeance. So much so, in fact, that for the past couple of years, a problem pretty old to the California and New England areas has become evident. With so many repeaters in operation, and with about 90% of them on 34/76, we had the old problem of high powered base stations in Tampa keying the Miami repeater, and vice versa. After a while, the Melborne repeater came on, and later was joined by the Boca Raton machine, 43 miles north of Miami. It got to the point where most people were shutting off their receivers because they were having to listen to too many one-sided conversations not meant for them.



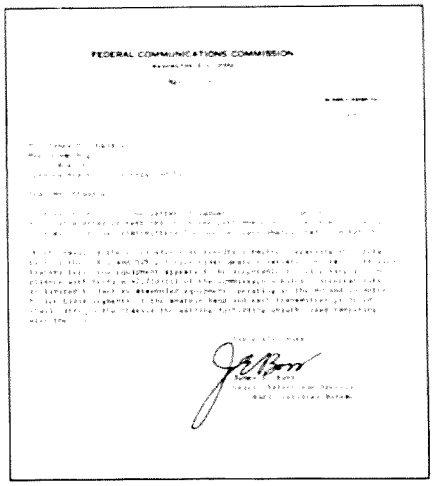
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Then, about eight months ago, the Orlando repeater came on in the center of the state. Poor Melborne. Poor Tampa. Orlando base stations were consistently keying up their repeaters with 20 dB to full quieting signals. Melborne even changed their receiver antenna orientation to reduce the problem (and in doing so, though, they removed repeater coverage from a rather barren stretch between Orlando and Melborne, a nice place to have a flat tire). At the same time down in Miami, the Boca repeater was going strong. It put usable signals into Miami, and communications took on quite an interesting assortment of squeals, grunts, and shouts of "Hey, control station, please shut this &S#¢% machine down so I can talk to Boca."

Up to now I've described a situation very familiar (or it may soon be) to most of you. Here is the solution that the South Eastern Repeater Association committee, headed by Hal Greenley K4GYO, proposed, and which was adopted by all of the S.E.U.S. repeaters:

On January 15, 1972, all of the S.E. repeaters changed their main input frequency to either 146.16, 146.22, or 146.28 MHz. The specific frequency allocations were made by the committee, based on factors including location, seniority, adjacent repeaters, etc. These inputs are "open," that is, no tone coding of any kind. Each repeater also maintains a 146.34 MHz input. This 34 input is Touchtone coded with a different code assigned to each repeater. The code performs a latching function (at the discretion of each repeater) or a time delay. For instance, if the Miami repeater 34 input hears a digit one, it will open, and leave open, the 34 input of the machine, until it hears another digit one, when it will close the 34 input. The 16, 22, or 28 inputs will have priority over the 34 input. So if a station comes on 16, the 16 station will take over, or capture the repeater, even if a station is already transmitting on 34.

Several months later, each repeater will change its output frequency to 146.76, 146.82 and 146.88 MHz respectively.

Now, what have we gained from this mildly expensive and time consuming area-wide change?

First of all, by careful frequency assignments, mobiles using one repeater will not – under normal conditions – be able to key up the closest repeater using the same channel. Notice that I said mobiles. What about base stations?

All base stations will be requested to use the 146.34 inputs. This serves several purposes. First and foremost, it allows a mobile, any mobile, and even an HT, to break into a chat by a base station to request help, report accidents, etc. (Remember our justification for existence – public necessity, interest, and convenience.) Secondly, it allows high powered base stations in Miami for instance, to talk through the Orlando repeater without keying up, or tying up other repeaters around the state. Toward this end, all the individual repeater need do is to keep its 34 input tone coded off when not in use. The repeaters with 34 coded off will not be bothered by the long haul conversation. Of course, two cross-state conversations at once could pose a problem, but then nothing (yet) is perfect. I might also point out that traveling mobiles who can't cram in two more sets of crystals can utilize the 34 input of any repeater he is near with his Touch-tone pad. The only disadvantage for mobile use of 34 is that several repeaters will only operate one centralized 34 receiver while they may have several satellite receivers on their main discrete frequency. Third, if more areas conform to these standardized channels (and they are), only three sets of crystals will be necessary to cover most of the country. Rick WB4IES, and I recently took a light plane trip from Miami to San Francisco and back; we know we missed more repeaters than we worked. Also, the many combinations of PL tones described in several magazines won't be necessary.

This is the beginning of the standardization which is so necessary to our continued expansion. This plan, which you notice incorporates 600 kHz spacing between the repeater transmit and receive frequencies allows more practical one-site repeaters. Another not so obvious advantage is that standard 600 kHz spaced, 60 kHz staggered channels make frequency synthesis somewhat easier to produce.

Certainly there are some objections and disadvantages to this plan. The most often heard seems to be the expense of the new crystals and the fact that "We were here first, why should we move?" Well, the expense, especially in the field of ham radio, is rather minimal. It is interesting to note, however, that most forms of improvement and progress cost some money. This isn't the first and certainly not the last such instance. To the other objection, that of "squatters' rights," I say this: Each motorist on the road has given up some of his freedom – such as having to stop at a traffic light when he is in a hurry. To go further, the nations of the world have given up some of their freedoms – such as not indiscriminately testing nuclear weapons. This giving up of "rights" is done in order to bring about the greater good of all. The same thing holds true here. I read a very disturbing article recently where a group of irate two meter hams had a repeater evicted from a beautiful mountain top site because it was bleeding into their receivers 30 kHz and ten miles away. At this, I can only shake my head.

All in all, two meters is growing; well in some areas, and poorly in others. If we all give just a little we may one day see a beautifully interlinked repeater system not only in Florida but extending toward the rest of the country with autopatch facilities and possibly FAX or TV. Atlanta and Florida are even now beginning to talk of a link!. And remember, amateur satellites can do more than broaden our horizons – they can literally jump them!

Repeaters are becoming more prevalent, and with a consistent, carefully planned *system*, each repeater will be covering a larger and larger area without bothering its neighbor. And remember, if the FCC receives many complaints from irate repeater groups they could justifiably impose their own rules. We have traditionally been a self-policing group, and it would behoove us to retain this system.

The future? It's governed by what we do today! Remember how the fantastically complex Bell system started.

. . .WA4RLG

Ed Webb W4FQM/1
Technical Editor
73 Magazine



Ross and White RW-Band Tranceiver

The Ross and White RW-Bnd 2 meter FM transceiver is one of the newer entries to the FM market place, and it brings with it several unique features.

You can put it in your glove compartment, it is so small. The front panel mike socket lets its trim design slide into narrow places, like the empty hole in your dashboard where the AM radio used to be. If you prefer to keep it outside, you can mount it underneath the dash or on the transmission hump with the mounting bracket that is included. And this rig is portable too. You can use it with a shoulder strap and flashlight batteries. Its size is deceptive because it is loaded with features. Keep reading.

The little knob at the side is for the built-in tone burst encoder. More and more repeaters are requiring tones to activate the transmitters and other functions of the repeaters, such as low band links. In some areas that have several repeaters with the same input frequency, a different tone is required to turn on each particular machine. Other rigs require externally connected boxes that have the tone generators inside. The generator is already inside the RW-Bnd. These tones are easily reached for field adjustment and the three switchable positions should be sufficient even for the frequent traveler. Since the tone circuits use ICs, they are trouble free and should require no maintenance at all.

You will notice that there are four knobs on the front panel. There is a volume and a squelch control as with all others. To turn it on, you turn on the volume and adjust it for a comfortable noise level with the squelch open. Right? Wrong. Once you have adjusted these two controls you should not need to adjust them again because the main power switch is included in the power level switch. There are three power levels (plus 'off') that offer a variety of operating conditions. The low power slot is fine for talking to the mobile who is following you. No need to tie up a lot of other people on the direct channel. The medium power level is perfect for keeping in touch with the base when you head out for a loaf of bread. Incidentally, these two levels are satisfactory for portable operation using batteries or other situations where low current power suplplies only are available, such as when you are on a business trip. The usefulness of this rig for emergencies is self-evident; low current drain, built in tone burst, and small size. If there is no emergency and you are just talking to the distant repeater several cities away, the high power position is the ideal level as this allows the rig to run ten-plus watts output to the antenna.

Do you have visions of plugging your rig in and pushing the mike button and watching the relative rf output meter quickly flash to maximum and then crashing to zero? This will not happen with the RW-Bnd because it has

a protection circuit that prevents the final transistor from blowing out if the swr is too high, such as when you forget to connect the antenna or a low tree branch takes it off.

The circuitry is modern and of advanced design. For example, the transmitter uses an IC oscillator. Most other rigs do not have an IC here. In the receiver, the sharp i-f does not block or get cross-talk from adjacent channels. Once inside the rig, you will notice that there is a lot of room. You will be grateful for this when you try to change crystals for the transmitter or receiver becuase there is room to get a couple of fingers in there and you do not have to use a pair of pliers that might pinch the crystal. Each rock has a trimmer capacitor to let you get it exactly on frequency, transmit and receive. Twelve channels are sufficient for most areas and this is what you have in the RW-Bnd. In case one of your local repeaters has not switched to the standard 600 kHz spacing, crystal jumpering is easy.

Once the rig is installed, the clear, clean and plentiful audio will strike you. The front mounted speaker is what does it. The audio is not directed at your feet nor is it muffled in the maze of wires behind the dashboard. You will not need to hook up an external speaker to hear this one. Another useful feature is the accessory jack on the rear panel. It is connected to nothing. Your own needs and imagination are the determining factors here. Do you use a Touchtone pad? Tie it in here. Do you use a continuous tone squelch system (PL)? Attach it to this plug. Perhaps you want to run the audio output to another speaker in the rear of the car. It is easily done. You can even bring out test points for monitoring the functions of the rig.

One other valuable contribution the Ross and White people have given the ham for maximum enjoyment of his FM rig is a complete instruction manual. Book is a better word to use. It has pictorials, parts placement pictures, voltage tests, operating theory, and more. It is a valuable volume for the proud RW-Bnd owner.

For more information about this great rig, contact Ross and White at *50 West Dundee Road, Wheeling IL 60090*. . . .Staff

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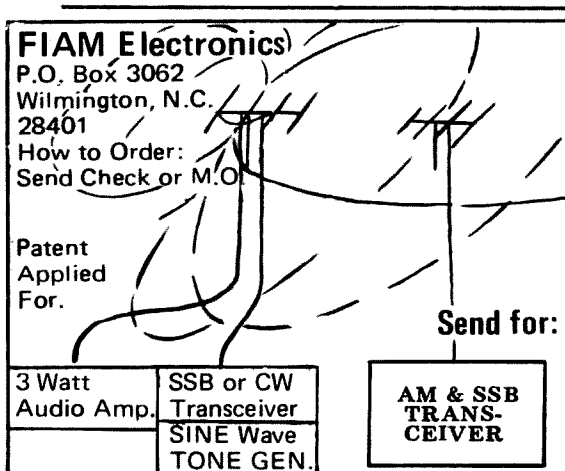
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FROM JIM, WN5COZ

NOAA Studies Ionospheric Effects of Thunderstorms

Reprinted from Collector and Emitter, a publication of the Aeronautical Center Amateur Radio Club of Oklahoma City, Oklahoma.

Scientists of the Commerce Department's National Oceanic and Atmospheric Administration have found that thunderstorms transmit tremendous sound pulses into the ionosphere 125 miles above the earth.

By observing these high-altitude perturbations with carefully sited radio transmitter/receiver arrays, the scientists have determined that a pulse can give the ionosphere a three-mile lift directly above the originating storm.

Dr. Kenneth Davies of NOAA's Apace Environment Laboratory at Boulder, Colorado, says the ionosphere begins responding to thunderstorms about the time their tops have reached the 40,000-ft level.

The turbulence within the thunderstorm produces pulsations which travel through the atmosphere as pressure waves. Unlike radio waves, which penetrate the atmosphere without affecting the natural gases through which they pass, these pressure waves move by a

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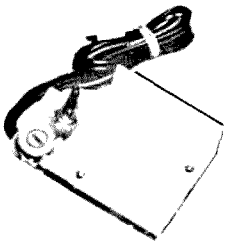
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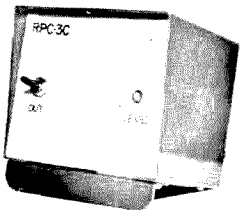
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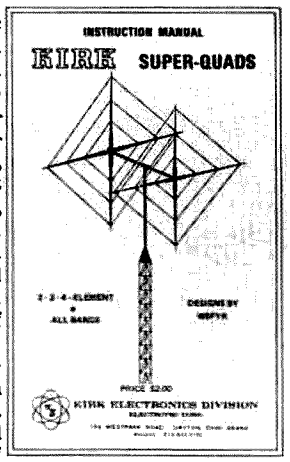
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train of collisions between molecules along the path. As a molecule of atmospheric gas is perturbed by the pressure wave, it moves, striking a neighboring molecule which in turn moves and strikes another.

These infrasonic pulsations originate in the lower atmosphere (troposphere), where the molecules of gas are packed densly, so that each molecule travels a short distance before striking another (less than one millionth of an inch). As the pulsation travels upward to the ionosphere, the atmosphere thins and the molecules are farther apart. At an altitude of 125 miles; the molecules of gas are so thinly distributed that one may have to travel 1,000 ft before colliding with another. This density reduction is responsible for a 1,000 times amplification of the vertical movement of the atmosphere at ionospheric altitudes. The actual upward surge of the atmosphere (not the individual molecules, but the whole mass of air in the region affected by the acoustic pulse) is about 15 ft at cloud level and 15,000 ft in the ionosphere.

Because of the geometry of the earth's magnetic field, the electronis in the ionosphere behave differently from the neutral gases, which are unaffected by geomagnetism. South of the detection array, the atmospheric surge carries across the magnetic field lines. The neutral constituent moves upward normally, but the charged electrons are restrained by the field. Because radio signals are reflected from the electrons and not the neutral part of the ionosphere, the movement cannot be observed.

To the north, however, the atmospheric pulses move along the magnetic field lines, and the electrons easily move with it. Thus, the surge of the ionosphere can be observed by reflections from the mass movement of electrons north of the transmitter/receiver array.

Observations indicate, according to Davies, that when ionospheric responses to thunderstorms occur, the top of a cumulonimbus cloud has risen to more than 40,000 ft within 150 miles of the midpoint of the radio circuit. Such responses have been recorded on the Oklahoma paths and on paths between Long Branch, Illinois, and Boulder, Colorado.

Reporting in the Journal of Atmospheric Science (March 1971) on studies of the ionospheric responses, Davies and John E. Jones, also of NOAA's Space Environment Laboratory, cited two principal advantages of using the ionosphere to detect the pulsations generated in the troposphere: (1) the density decrease with altitude in the atmosphere provides natural amplification of the generated pulses, and (2) the atmosphere acts as a filter to remove unwanted acoustic waves. In effect, the ionosphere is a natural tuned receiver. The amplification is several hundreds to one, although interference from acoustic waves of unknown origin does occur.

On the basis of present knowledge, it is difficult to relate the ionospheric measurements directly to characteristics of the thunderstorm. As with any new technique, a considerable body of data must be gathered and time spent in analysis before the relationships are understood. A 10 to 20-year lag between a scientific discovery and its routine use is not unreasonable, according to Davies.

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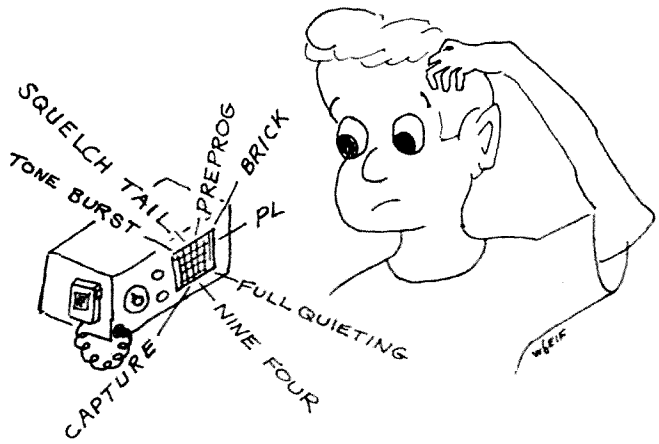
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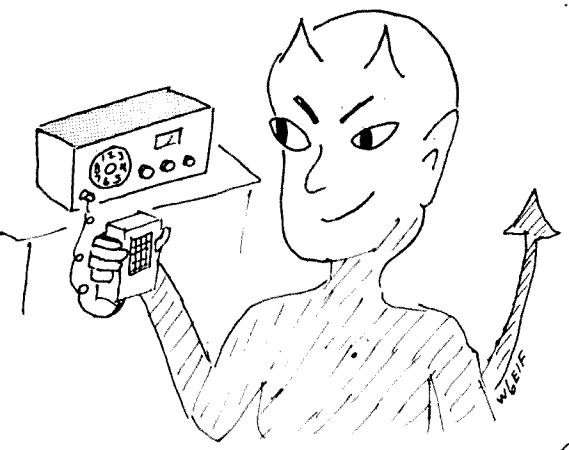
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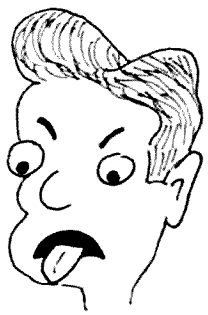
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The repeater jammer



Any other mode as seen by the FM'er

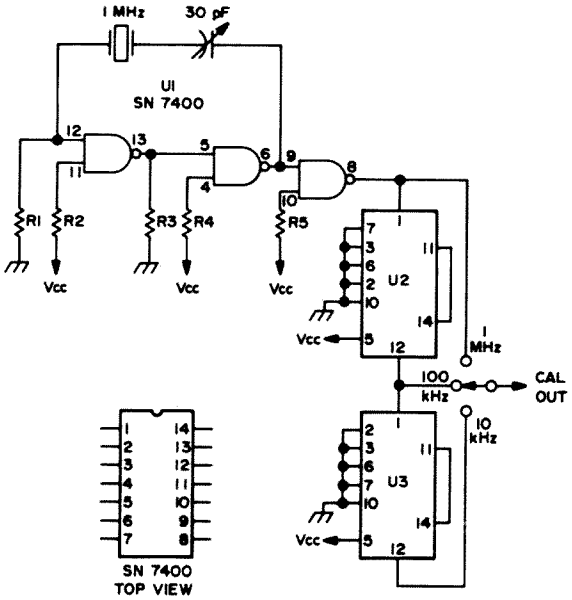


The FM'er

CIRCUITS, CIRCUITS, CIRCUITS...

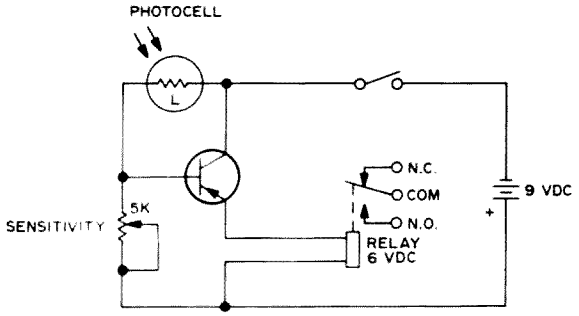
The following circuits have appeared in the referenced books, magazines, application notes, etc. While we try to reproduce all of the information that should be needed by an experienced constructor, readers may want to avail themselves of the original sources for peace of mind.

Readers are requested to pass along any interesting circuits that they discover in sources other than U.S. ham magazines. Circuits should be oriented toward amateur radio and experimentation rather than industrial or computer technology. Submit circuit with all parts values on it, a very brief explanation of the circuit and any additional parts information required, give the source and a note of permission to reprint from the copyright holder, if any, and the reward for a published circuit will be a choice of a 73 book. Send your circuits to 73 Circuits Page, 73 Magazine, Peterborough NH 03458.

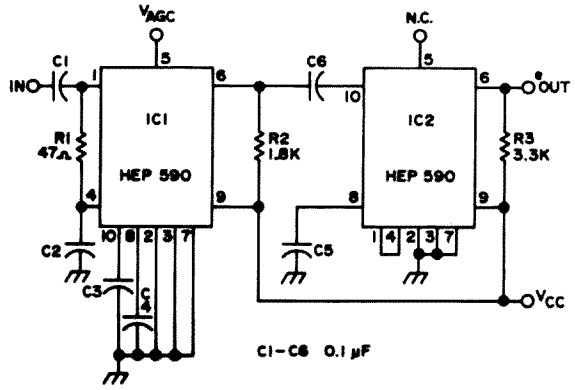


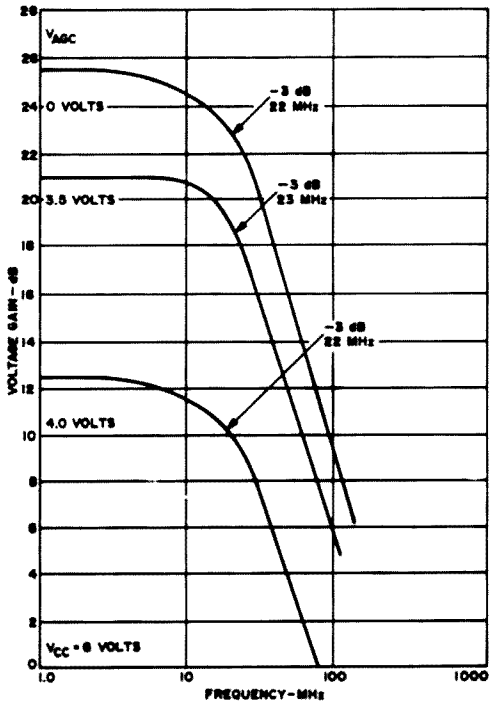
R1, R3	1.8K	
R2, R4, R5	1K	
U1	SN 7400	QUAD 2-INPUT NAND GATE
U2, U3	SN 7490	DECADE COUNTERS
Vcc	5 VDC	

This crystal calibrator has a fundamental 1 MHz crystal and its frequency is divided to give outputs of 1 MHz, 100 kHz and 10 kHz. All the parts used are easily available from Polypaks, HAL Devices, etc., for a small fee. Circuit courtesy of Zero Beat (Victoria BC) for November, 1971

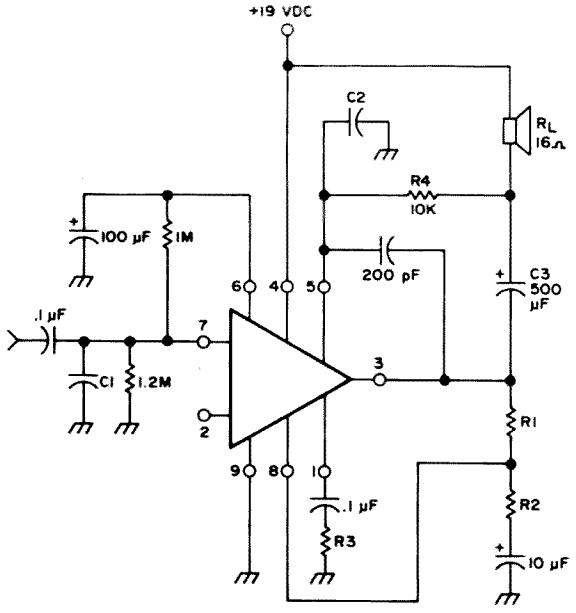


Turn anything on — or off — with light. Use it to trigger an alarm, to turn on lights at dusk, activate a counter as people pass. . .or whatever. Easy-to-build versatile circuit courtesy of Calactro Handbook. Transistor is a Calectro K4-505.

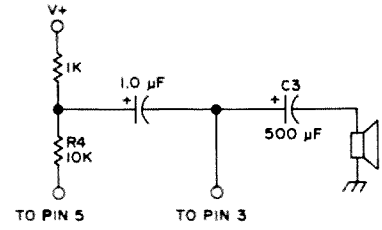




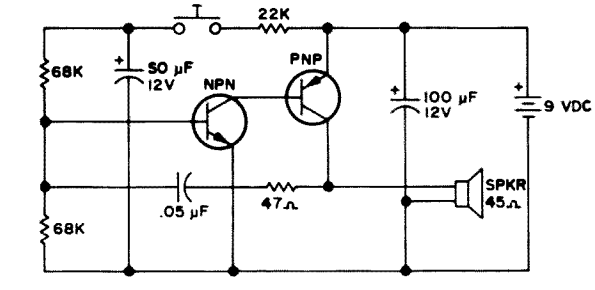
Two stage video amplifier with AGC control of IC gain and no tuned circuits required. The curve shows the video amplifier response with AGC. This circuit from Motorola HEP Radio Amateur's IC Projects HMA-36, available free from Motorola, Dept. 73, Box 20924, Phoenix AZ 85034.



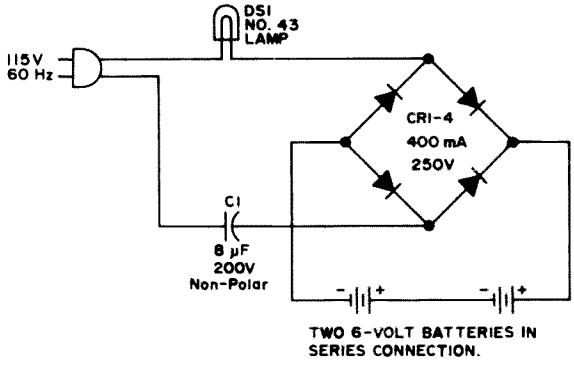
SENSITIVITY FOR P_o mV	C1 pF	C2 pF	R1 k OHMS	R2 OHMS	R3 OHMS	R_L OHMS	P_o W
600	0	0	10	1.0K	82	16	2.0
15	100	100	51	100	2.2K	16	2.0



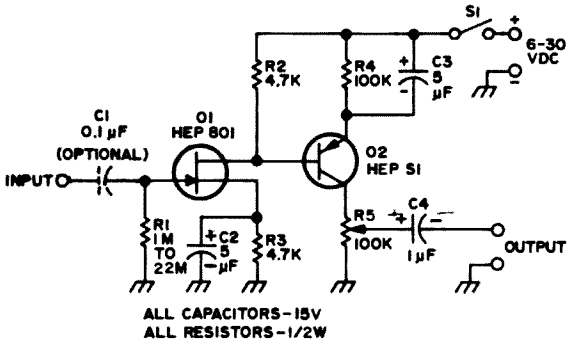
A typical circuit application utilizing a Motorola MFC9010 monolithic functional circuit, which is a 2-watt audio amplifier designed to provide the complete audio system in TV, radio and phonograph equipment. Schematic at right shows alternate connection to permit connecting speaker to ground instead of to V+. Circuit courtesy Motorola Functional Circuits handbook.



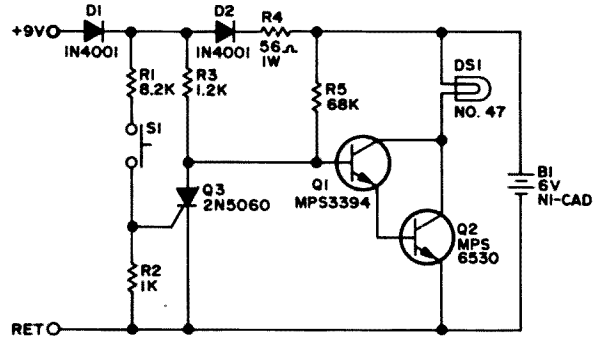
Another Calectro circuit, this one a screaming siren. Tone rises and falls like the big ones. Circuit courtesy Calectro Handbook (50¢), 400 S. Wyman, Rockford IL 61101. Q1 is a Calectro K4-506, Q2 a K4-505, S1 is a push button switch.



Simple ni-cad battery charger circuit from FM Magazine, as reprinted in The Best of FM, an anthology of articles from FM Magazine published by 73 and available from 73 Magazine, Peterborough NH for $4.95.



Audio amplifier. This circuit has a high impedance input, low current drain (0.2 mA), low impedance output, wide range (10- 30,000 Hz) and a gain of 200 to 400. Circuit courtesy Motorola HMA-33 Tips on Using FETs.



Power failure indicator. Indicates either momentary or continuous power failure. Circuit courtesy Motorola Semiconductor Power Circuits Handbook. When circuit is reset it will trickle charge the battery, keeping it at full charge.

EXTRA CLASS LICENSE STUDY GUIDE

Questions & Answers Part I

The Extra class amateur license is the highest rank of license offered, and as such demands the greatest knowledge of radio and electronics theory and practice (in fact, the Extra class exam requires at least as much knowledge as does the First Class Commercial Radiotelephone license with radar endorsement, generally accepted as being the most demanding of all FCC exams).

Because of the greater requirements of the Extra class license, its official study list of questions is the longest and most detailed of all the FCC study lists, totalling 90 questions. For comparison, the General class study list contains only 52 questions and the Advanced class has 65. What's more, the Extra class questions frequently call for detailed discussions of the subject rather than simple one-sentence replies.

Because of the greater detail and larger number of questions to be covered, we've divided the Extra Class Q&A portion of this license study course into two sections of 45 questions each. This section contains the first 45 questions, with our answers. The next one will contain the remaining questions, 46 through 90.

We must emphasize that this is merely a checklist which you may use as a "final exam" to test your readiness for the Extra class exam. Explanation of the material has been held to the mimimum; for details, refer to the Extra class study series previously published in 73 Magazine, or our reprint of the series.

1. What are sideband frequencies? During 100% sinusoidal amplitude modulation, what percentage of the average power is in the sidebands? How is the sideband power related to the percentage of modulation?

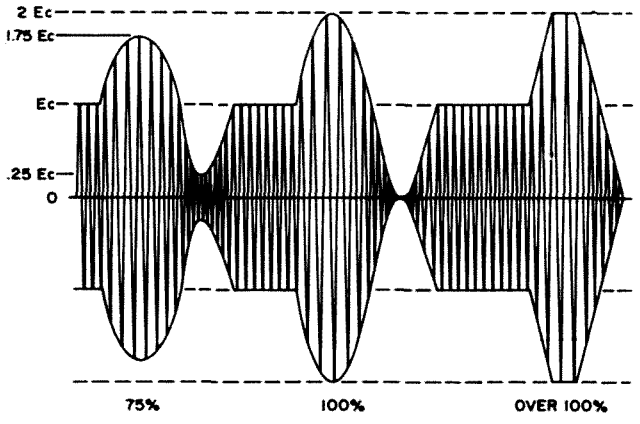
A. Sideband frequencies are those frequencies contained in the "sidebands" of a modulated signal. The sidebands consist of frequencies above and below the carrier frequency, which correspond to the sum of carrier and modulating frequency, and the difference, respectively. If the carrier is modulated by a single frequency, the side frequencies will also be single frequencies. If the carrier is modulated by a band of frequencies (as is usually the case, for voice transmission) the sum and difference signals become bands also, accompanying the carrier.

During 100% sine-wave AM, one-third of the average envelope power (total signal power) is in the sidebands and two-thirds is contained in the carrier. That is, the sidebands contain half as much power as the carrier.

Modulation percentage is based on a voltage measurement. Power varies as the square of the voltage, so the power content of the sidebands will vary between 0 and 1/3, proportionally to the percentage of modulation as it varies from 0 to 100.

2. What do the modulation envelopes of amplitude-modulated waves with 75%, 100%, and greater than 100% modulation look like?

A. Refer to Fig. 1 for views of the modulation envelopes.



3. How may a limiter be employed in an FM receiver?

A. In an FM receiver, the purpose of the limiter is to remove all amplitude variations from the received signal, thus reducing atmospheric noise (which consists primarily of AM components).

4. What precaution(s) should be taken when measuring the rectified grid voltage in an oscillator with a dc voltmeter?

A. For the protection of the voltmeter, all rf energy should be blocked from reaching the voltmeter by use of an rf choke in series with the voltmeter "hot" lead. To assure that oscillator operation suffers minimum disturbance, a high-impedance voltmeter should be used, and care should be taken to avoid introducing stray capacitance.

5. What is meant by frequency shift keying and how is it accomplished?

A. Frequency shift keying (FSK) is a form of modulation usually used in RTTY operation in which the "mark" condition is represented by a signal at one frequency and the "space" condition is represented by a signal at another frequency. One of the two signals is always present, but they are never present simultaneously.

FSK is usually accomplished by switching a small capacitance into and out of the oscillator resonator circuit, to produce the lower of the two frequencies when the capacitor is in the circuit, and the higher when it is out of the circuit. This switching is frequently accomplished by diodes.

6. Why is there a practical limit to the number of stages that can be cascaded to amplify a signal?

A. The amount of amplification which can be applied to any signal is limited by the unavoidable electrical noise introduced both by the early amplifying stages, and present with the signal when it enters the amplifier.

The final limit is reached when the noise that accompanies the signal at the input to the amplifier is the controlling factor. "Low noise" amplifiers are designed with the intent of reaching this limiting condition, and it can be reached in practice at all frequencies in normal use, from the audio range through SHF.

Certain techniques of "coherent detection" make use of a prior knowledge of the nature of the expected signal to dig into the accompanying external noise for the signal. Such techniques, for instance, make possible radar measurement of the distance from Earth to Venus, and are used in many types of communications. Even these techniques, though, are ultimately limited by the random and unpredictable nature of background noise.

7. What are A5 and F5 emissions? On what amateur frequencies can these emissions be transmitted? Can A5 emission be transmitted satisfactorily using one sideband only?

A. A5 and F5 both designate video signals; A5 means amplitude-modulated video, while F5 stands for frequency-modulated video.

Since video signals cover a bandwidth from dc up to several MHz, A5 signals are seldom satisfactory if transmitted using one sideband only, due to phase shift of the low-frequency components. To overcome this situation, yet reduce the extreme bandwidth which would otherwise be required, commercial television uses the "vestigial sideband" method to transmit by A5 signals. A vestigial-sideband signal is a normal DSB (with carrier) signal at very low frequencies, but one sideband (normally the lower one) is cut off at 750 kHz, so that at modulating or sideband fre-

quencies greater than 1.25 MHz the signal is single sideband. Between 750 and 1250 kHz, the lower sideband is rapidly attenuated. Thus a video bandwidth of 4.5 MHz is compressed into a channel only 6 MHz wide, including guard bands and audio information.

Both A5 and F5 emissions are legal on all amateur bands above 420 MHz.

8. How does amateur TVI usually affect television reception?

A. Alarmingly. The interference may manifest itself in any of a number of ways. Either the audio or the video parts of the TV signal, or both, may be affected.

If audio is affected, the TV viewer usually hears a distorted version of the amateur's transmissions. This is usually due to audio rectification, the same action which affects hi-fi and stereo sets, BC radios, hearing aids, etc.

Effects on the video may be varied. If a beat between the amateur's signal and the TV signal occurs, a cross-hatching may appear on the screen. If the beat frequency is low, this may show up as vertical bars across the picture. If the beat is high in frequency, it may be cross-hatching or simply a "grainy" appearance.

In severe cases, TV reception may simply be blotted out due to overload of the TV-set front end.

Video interference due to the amateur's audio modulation usually shows up as flickering horizontal bars of dark and light. This is true if the amateur uses AM. With FM, a cross-hatching which flickers in step with the audio occurs.

Cross-modulation interference may cause the sound of a local FM station to appear in place of the TV channel's sound, and it's possible for all these effects to occur at the same time (though highly unlikely).

9. Describe briefly the basic sections of a single sideband (SSB) transmitter. In what section of a properly operating SSB transmitting system is distortion most likely to originate? In what section is nonlinearity most likely to originate?

A. The basic sections of an SSB transmitter are the audio and sideband generation portion, the frequency control portion, and the power amplifier. The audio portion restricts audio from the microphone to the frequency range necessary for effective communication, and the sideband generator translates the frequency spectrum of the speech from the audio range into radio frequency (usually at some fixed frequency, to facilitate separation of the desired sideband). The frequency control portion translates the SSB output of the sideband generator into an SSB signal at the desired output frequency, and the power amplifier brings the signal's power level up to the desired point for radiation.

Distortion most usually occurs in the power amplifier portion of the transmitter. Nonlinearity, being a specific form of distortion, also is most likely to occur in the power amplifier, but may occur at any point within the transmitter. Once it occurs, it cannot be removed from the signal.

10. Define what is meant by the time constant in a resistance-capacitance circuit? How is the time constant determined?

A. The time constant is a measure of the speed with which the ciruit can react to step-impulse stimuli, and is a function of the product of resistance and capacitance in the circuit.

Time constant is determined by multiplying the resistance in ohms times the capacitance in farads, with the result being expressed in seconds. In practice, megohms and microfarads are the units usually used, with the result still coming out in seconds.

Time constant is sometimes defined as the time taken by the capacitor to reach 63% of full charge, through the resistance, and sometimes as the time taken by the capacitor to discharge to 37% of its original charge through the resistance. Both these definitions are accurate although incomplete.

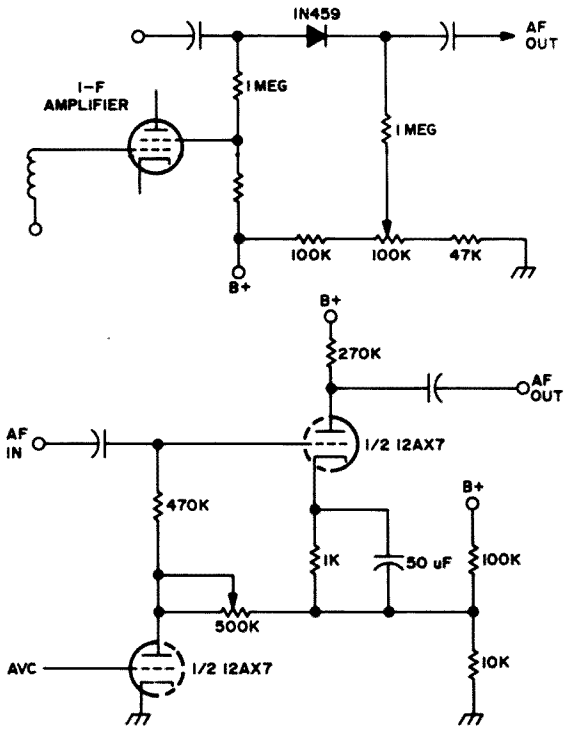
As a working rule of thumb, an RC circuit will be essentially fully charged (or discharged, as the case may be) within 5 time constants, although in theory full charge or total discharge cannot ever be attained.

11. How does a squelch circuit operate? Draw a commonly used squelch circuit.

A. A squelch circuit acts to silence the audio output of a receiver in the absence of

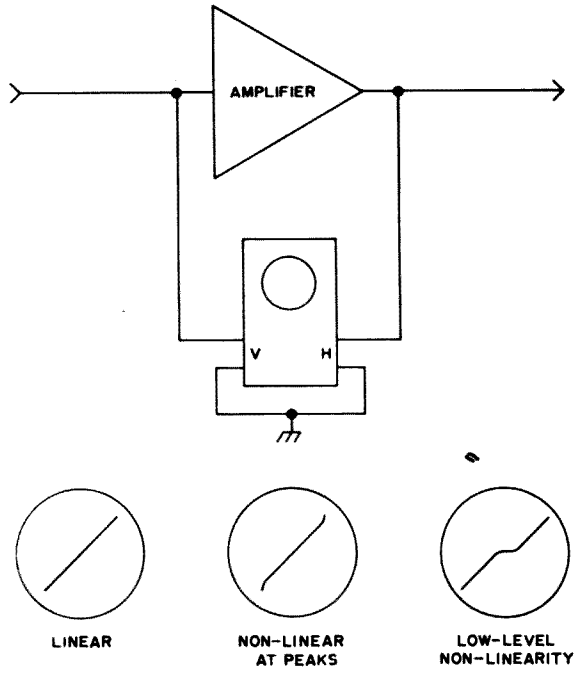
an incoming signal. Most often, the circuit either opens or shorts out the receiver's audio, between detector and audio amplifier, under control of a dc level obtained from the carrier of an incoming signal (usually the avc voltage). Some circuits, however, make use of "between-station hiss" to actuate the squelch.

Figure shows two typical squelch circuits, both operated from the avc line. When an incoming carrier causes an increase in avc level (more negative), the squelch circuit permits audio to pass through to the receiver's output.



12. An oscilloscope is used to study the relationship between the input and output of an amplifier produced by a voice signal. How would the scope pattern display a linear relationship between the input and output signals?

A. If the scope is hooked up as shown in Fig. , to directly compare input and output signals, a linear relationship would be indicated by a perfectly straight line on the face of the CRT. Any curvature in the CRT display would indicate loss of linearity at that point of the signal.

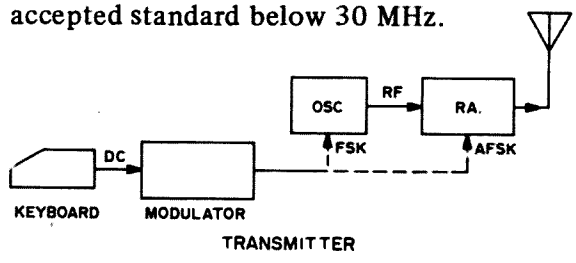


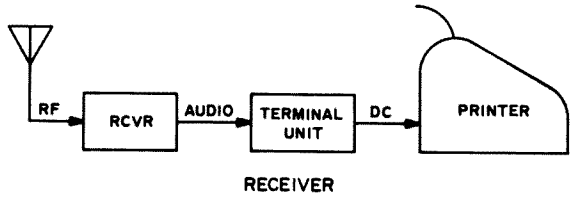
13. Draw a block diagram of an RTTY system showing the primary function of each stage. What is the proper way of identifying an RTTY transmission? What is the most widely used frequency difference between the mark and space frequencies in a conventional RTTY transmitter?

A. See Fig. for required block diagram.

An RTTY transmission should be identified by means of CW, as well as by transmission of all required information in the international teleprinter code.

The most widely used frequency shift is 850 Hz with 170 Hz rapidly becoming the accepted standard below 30 MHz.





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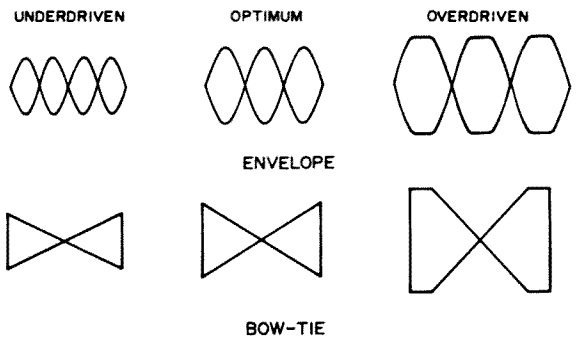
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14. How can the two-tone test output of a linear amplifier be used to tell if a transmitter is working properly? Show scope patterns for optimum, overdriven, and underdriven amplifier conditions.

A. The scope patterns produced by the two-tone test can be used to determine the audio input level at which peak flattening occurs in the output signal as shown in Fig. (in Fig. , the "optimum" condition is just prior to the point at which peak flattening begins to occur).

Some additional information may be obtained from a modulation-envelope display of the two-tone test, but it is highly subjective. More accurate data on transmitter working conditions is obtained from the "bow-tie" display. In this pattern, curvature of the sloping sides indicates nonlinearity. Flattening of the tips of the pattern indicates overdrive. With proper bias conditions, the crossover will be sharply defined; if bias adjustments are incorrect, curvature will occur near the crossover point although the remainder of the pattern may indicate perfect linearity.



15. Define the alpha cut-off frequency of a transistor. How is this parameter of use in circuit design?

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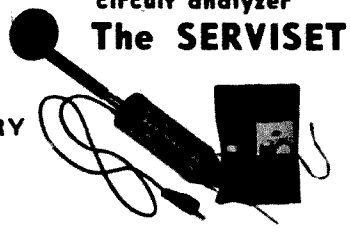
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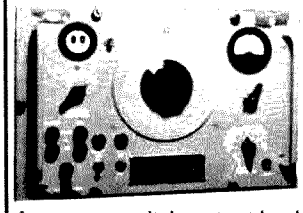
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A. The alpha cut-off frequency is that frequency at which "alpha" (common-base current gain) of the transistor drops to 71% (3 dB down) of its value at "low frequency" (normally 1 kHz). In other words, it is a measure of the high-frequency performance of the transistor.

Alpha cut-off frequency has little application to current circuit design, because the common-emitter circuit is more commonly used. It is, however, usually higher than the corresponding cut-off frequency for common-emitter circuits, and indicates the maximum frequency at which the transistor may be useful in amplifier, oscillator, and switching circuits. Normally, a transistor will oscillate readily at its alpha cut-off frequency, but may not function properly as an amplifier at this frequency.

16. What are inductive and capacitive reactance? How are their phase angles related? How does their reactance affect actual power dissipation in a circuit?

A. Reactance is a measure of the opposition to flow of alternating current. Inductive reactance is a measure of the opposition offered ac by an inductor, while capacitive reactance measures the opposition offered by a capacitance. Unlike resistance, reactance dissipates no power, but merely shifts the phase of current with respect to voltage, thus making a part of the power unavailable for dissipation.

Pure reactance of either type shifts phase by 90 degrees. With inductive reactance, the current lags the voltage by 90 degrees, and with capacitive reactance, the voltage lags 90 degrees behind the current.

In a circuit containing both reactance and resistance, only the resistance dissipates power. The power dissipation is reduced by presence of the reactance, because it makes a portion of the available power unavailable to the resistance.

Inductive reactance increases with frequency, while capactive reactance decreases with frequency. Thus at dc, an inductor is a short circuit while a capacitor is an open circuit, and at "infinite" frequency, the roles are reversed.

17. How does the positioning of a powdered iron tuning slug affect the frequency of the oscillator it is tuning?

A. Since the powdered iron slug has higher permeability than does air, as the slug moves into the coil it increases the inductance and thus lowers the frequency of the oscillator.

Brass has lower permeability than air, and is sometimes used for tuning slugs. When a brass slug is used, inductance decreases and frequency rises as the slug is inserted into the coil.

18. Define the deviation ratio in a frequency modulated signal.

A. Deviation or "swing" is the difference between the apparent instantaneous frequency of the modulated-signal envelope and that of the carrier. Deviation ratio is the ratio between deviation and the frequency of the modulating signal. Strictly speaking, it is the ratio between maximum deviation, and the maximum modulating frequency. In an amateur NBFM signal below 52.5 MHz, with maximum modulating frequency of 3 kHz, deviation ratio is not legally permitted to exceed 1.0.

19. What type of signal will be produced when the output of a reactance modulator is coupled to a Hartley oscillator and multiplied in frequency?

A. FM.

20. How would the reception of a single sideband signal be affected if the carrier is not completely suppressed? How can spurious signals in the output of the mixer stage of an SSB transmitter be suppressed?

A. The incompletely suppressed carrier may produce a beat frequency with the receiver's bfo if tuning is not exact. This beat appears as a low-pitched "growl," and may vary slightly in frequency as propagation effects shift the frequency of the incoming signal, or the bfo shifts slightly. In addition, the carrier may cause interference to other signals.

Spurious signals in the output of the mixer stage can be suppressed by proper design, by choosing input frequencies so that no mixer products except the desired one fall within the range of the output tuning circuits, and by the use of many selective tuned circuits between mixer and antenna. High-level mixers are to be avoided in the interest of suppression of spurious signals. . . .Staff

(to be continued in the May issue of 73)

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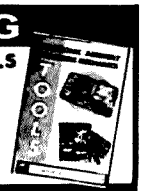
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The Poorer But Wiser Ham's FM Base Station

By this time FM is clearly here to stay and the confirmed FM addict wants at least a mobile and a base station, if not a walkie-talkie as well. The older, tube-type, commercial sets, although obsolete for their original intended purpose, offer the ham excellent sensitivity, power, and stability, and unless they are positively ancient, they offer a narrow passband as well. The latter is advantageous when you are digging for weak stations, assuming they are on frequency.

Since most of the commercial gear was mobile (there being as many as fifty mobile units for a single base station in some installations) it follows that an obsolete mobile unit is the cheapest and most available rig today. While much of this is hard to modernize into useable mobile material, all of it is easy to rebuild into base stations.

Now, as in other branches of the ham art, you will have to do a little extra work if you want to save extra money. For instance, as with the old recipe for bear steak that starts "first catch a bear," you must first find an old radio. This is easier to do than you might think just from reading the magazine ads, because the prices which the General Electric Pre-Progs, Motorola 80 D's, and similar rigs bring do not justify advertising them. However, find a firm that advertises more recent gear, write them or drop in at their warehouse and you will usually find the older, cheaper gear there and sometimes almost for the asking. Another good method is to have a friend inquire over the air, or check the goodie-row offerings at your nearest hamfest. At one last month, I bought a good Link 1905 receiver for $1. With $1.60 for two crystals from JAN and odd parts from my well-stocked junk box, it is now a serviceable 76–94 monitor receiver sitting in my bedroom. This is admittedly a better than average bargain, but you will be astonished at how much radio you can buy for how little if you go back about two model styles. I have bought working sets for $40 and you-fix-its for $5. See page 50, July, 71, issue of *73* for a representative list of dealers, or leaf through any current copy for others. If they advertise current type-accepted commercial FM gear, they probably have the less expensive earlier stuff, also.

There is no problem at all in getting circuit information and specifications for ordering crystals if you use either General Electric or Motorola gear, as there are books of prints advertised in the ham magazines nearly every issue. If you play with Link, RCA, Bendix, and some of the others, you may have to canvass the local ham fraternity for circuit data, but most hams will cheerfully let you Xerox any prints or instruction books they have, so do not fear the other makes, just prepare to do your homework if you use them.

Possibly the best buy is the GE Pre-Progress line (ES 12, etc.). These were six-volt units to begin with, although some were modernized in various ways to 12. Later models came in original 12 volt condition, but this is not really an advantage when you decide to convert to 110 ac, and you might save money as well as work by buying a six-volt model.

The advantage, other than cost, of the six-volt models is that the filaments are all in parallel. Whereas the original tube line-up employed low current tubes wherever possible (6BH6, 6BJ6, etc.) if you have a parallel filament circuit, you can substitute other tubes for increased gain, or just because they are more available. In the 12 volt versions, you must be sure the filament currents match properly on each side of the string or some tubes will be starved while others are over-fed. In addition to risking early tube burnout, such discrepancies can

do strange things to stage gain which will be hard to find.

The first thing to do is separate out the leads which must be fed low voltage dc, such as the relays, and those which can use ac, such as the filaments. A choice is available in supplying the high voltage, as follows: You can pull the vibrator out, feed low voltage ac to the old vibrator transformer primaries, and diode-rectify the secondaries. However, you will recall that the vibrator transformers expected 120 Hz ac from the vibrators, and used a divided primary. If you run 6 volts ac to half the primary, you will come up with about the right secondary voltage, but the transformer may become too warm. This varies from model to model and from make to make. The Link 1905-1906 series had husky transformers that run barely warm this way, but the GE rigs were engineered fairly close and run warm, while some other makes will actually burn up. However, if you have the ac in sufficient quantity to feed them (6 volts at up to 30 amps!) you can easily try this method and see whether the vibrator transformers will handle it. If they do, you are home free, or almost so. You still must supply dc to the relays, and the easiest way is to use a bridge rectifier across a filament winding, if it is not grounded. A separate low-current filament transformer may be required. With such a bridge rectifier, you may need no filtering. If you use a half wave across the regular grounded filament winding, you will need beaucoup capacity to keep the relay from chattering, but either method works.

There is a power limitation in using the old vibrator transformers as described. The GE Pre-Progs, for example, used two transformers, one for low voltage and the other only for plate voltage for the 2E26 final. The rig was planned for 7–10 watts output and that is about all that little transformer can produce. It does not help much to bridge it, because the increased current drawn will drop the voltage so that you are back about where you started. However, this rig can readily be "high-powered" if you build a new high voltage supply operating directly from the ac mains. To do this most easily, you pull out the old vibrator sockets and their transformers, leaving the electrolytic cans, as they will serve in the new supply. Either on the chassis, if you pick the right size, or somewhere else, you mount a TV transformer and bridge rectify it for the final plate supply, using the center tap for the general low voltage supply for the rest of the rig. FM transmitters do not require nearly as good filtering as do AM or sideband gear, so you need only add a new 8μF 1,000 volt oil filled paper capacitor for the final plate supply.

Since you will be using about double the old plate voltage, you might as well substitute a 6146 for the 2E26 and get the added wallop it can produce. Some Motorolas used two 2E26's and you can plug in two 6146's in place of them directly. If you try this on the GE ES16, you will find that the sockets are too close together. Take heart. Simply remove the metal shields from the bottom of the tubes (carefully!) and then file a flat side on each tube base where they would otherwise touch. (One tube will be for the right hand side and the other for the left hand side, not interchangeable.)

On any such gear, inspect the high voltage bypass capacitors closely, because most of them will not stand doubling the ratings, as we are now doing. Be sure also that any dropping networks deriving voltage from the final high voltage supply are correctly reengineered. On most sets, this latter is unnecessary as the manufacturers did not want to waste any more power than they had to waste, and so the high voltage supply (vibrator or dynamotor) delivered only its full output to one terminal.

This may sound like a lot of work, but actually it should take only a few evenings, even if you have never done it before. The result will be a high quality signal at good power and minimum cost. With crystals, the new power supply components, and the usual number of tubes and other repair parts, it should never exceed $75, but don't judge it only by the present cost. Remember, this old mobile junk originally cost upwards of $1,000!

One of the happiest accidents about the Pre-Prog receivers is that while they were originally designed for wide-band reception, the loading on the i-f coils is such that if you merely peak every coil precisely on frequen-

cy ("Christmas tree them") you will achieve a pass band about 15 kHz overall which is highly compatible with modern narrow-band equipment. The overall gain, of course, improves in this process and the receivers are quite satisfactory without additional pre-amplification, although putting a good transistor preamp ahead of them makes them as hot as you could possibly want. Originally rated at .6μV for 20 dB of quieting, when the i-f strip was stagger-tuned to 120 kHz wide band service, returning brings most of them to .5 or better, and a pre-amp drops them to .2 or .3. The squelch action is uniformly good.

One additional modification which I heartily recommend, but which is certainly optional, is junking the typical carbon mike in favor of a reluctance, ceramic, or other better-sounding type. If you rework a Pre-Prog in this way, you can get an added advantage of a well compressed audio signal as well. Remove the mike transformer and you will find that the hole in the chassis exactly fits a 9 pin socket. Wire a two-stage triode amplifier here, using a 12AT7 or equivalent, and feed the resulting signal to the existing audio tube, just as if it were coming from the secondary of the mike transformer. The easiest way to do this is with a 9 pin Vector socket, so the two entire stages can be built externally and then just set in place. It does require a special shield that mounts on top of the chassis, but I always use a 35mm film can instead, because they are more available (punch holes in it for ventilation!).

This will now drive the modulator tube into compression, and when you set the deviation control to the proper point, you will have a high-average, or loud-sounding, though narrow, signal. The gain required of the first stage depends on the mike, so try a 12AX7 and a 12AU7 in the socket before you quit, and select the one that gets you the best on-the-air reports. . . .WA4UZM

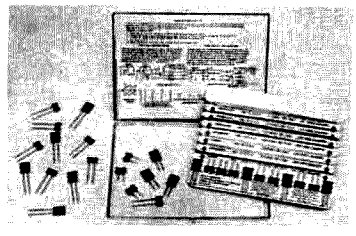
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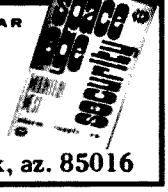
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All solid state.

73 Magazine is published monthly by 73, Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas. $7 per year elsewhere. Two years $11 in U.S. and $12 overseas. Three years $15, and $16 overseas. Second class postage paid at Peterborough NH, and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A. *Entire contents copyright 1972 by 73 Inc., Peterborough NH 03458.* *Phone: 603-924-3873.* *Say, don't forget that little old tour of Europe this fall. You'll enjoy it a lot more amid cohorts who speak your own language, and you'll love meeting the European amateurs. Also, if you are within driving distance of FM West in Fresno on June 2, say hello to Wayne. He'll be there, working hard on the fight to save the 220 band from the chaos of 27 MHz. In May Wayne will be on from Navassa with the Atlanta gang as KC4DX, so don't miss that DXpedition. In June Wayne expects to be visiting Jordan again for a follow-up on his 1970 visit. In October it looks as if 73 will be exhibiting at the Hudson Convention for the first time in years . . . ! Keep the faith.*

Amateur Radio

MAY MCMLXXII Monthly Ha

AMATEUR RADIO WEEK PROCLAIMED



Mayor Walter Taylor, Englewood NJ signs a proclamation declaring June 18 to June 24 as Amateur Radio Week. Watching Mayor Taylor are WA2RIN, WA2NVG, and WA2CCF.

'72 ARMED FORCES DAY COMMUNICATIONS TESTS

Each year, on the third Saturday in May, the Department of Defense sponsors the observance of Armed Forces Day. This year's observance, the 23rd, will be held on Saturday, May 20, 1972. As in past years, as one of the many Armed Forces Day Programs and in recognition of the radio amateur's contributions to the field of communications, emergency services, and maintenance of morale among servicemen , the Departments of the Army, Navy and Air Force will conduct radio communication tests. These tests are designed to be a tangible demonstration of the firm and long-standing Department of Defense policy to encourage and support amateur radio activity.

The communication tests will consist of military-to-amateur crossband operations, using continuous wave (CW), voice (SSB) and radioteletypewriter (RTTY) modes of operation and "CW" and "RTTY" receiving tests. Special QSL cards confirming crossband communications will be forwarded to those amateurs who establish two-way contact with participating military stations.

A CW receiving test will be conducted for any person capable of copying International Morse Code at 25 words per minute. The CW broadcast will consist of a special Armed Forces Day message from the Secretary of Defense addressed to all radio amateurs and other participants.

A RTTY receiving test will be conducted for any station possessing the required equipment. This is a test of the operator's technical skill in aligning and adjusting his equipment, and serves to demonstrate the growing number of amateurs becoming skilled in this method of rapid communications. The RTTY broadcast will consist of a special Armed Forces Day message from the Secretary of Defense to all radioteletypewriter enthusiasts. The message will be transmitted at 60 words per minute.

HAMS PROVIDE LINK TO W.VA. FLOOD AREA

Reprinted from the Wheeling News Register, March 6, 1972.

As the death toll mounts and hope for the survival of the missing fades, amateur radio operators manning emergency communications in the Logan County disaster area are called to check the official death list with increasing frequency.

Since the Buffalo Hollow Creek flood tragedy 10 days ago, hundreds of ham radio operators have assisted in maintaining a precarious communications link with the devastated area and the outside world.

For C. W. "Gibby" Welsh of McMechen, ham radio operator since 1931, his kitchen-side radio room has been a front row seat on the disaster. He and his wife, appalled by the magnitude of the tragedy, marvel at the fortitude and perseverance of radio operators in keeping the air waves open 24 hours a day since the wall of water swept through the mining camp-dotted valley.

Within hours after the flood, a radio operator in Mallory, W. Va., two miles below Man on Buffalo Creek, sent out the first eye-witness reports of survivors, Welsh says. He stayed on the job for days until a net control was designated by the West Virginia Emergency Network.

Today station W8ETF in St. Albans, W. Va., is still receiving messages from friends and relatives of Buffalo Creek residents seeking news of their health and welfare.

Expressing his pride in the devoted service provided by the amateur radio operators, Welsh reports hearing of hundreds who volunteered their service during the ordeal since the flood. He isn't surprised, though, because ham radio operators have traditionally provided people-to-people contact throughout the world in time of need. The circle of friends ham operators acquire around the globe cover the world. Generally the contacts radio operators make are on a strictly for friendship basis. But when disaster strikes, they fill the breech left by downed telephone lines and washed out roads or more often supply the communications link where no other exists.

"If everyone was an amateur radio operator, this would be a more peaceful world," says Gibby Welsh. In the meantime, everyone can share in the pride Welsh feels for the tremendous job being done by West Virginia's ham radio operators.

Relayed by Fred McGee, Moundsville, WV.

News Pages

ANTARCTIC DRAMA
HAM HELPS SAVE PLANES

On 28 February at 6:55 PST, amateur radio operator W6AJZ, Peter Lovelock, of Santa Monica, responded to an emergency call from KC4USP, National Science Foundation Radio at Palmer Station, Antarctica.

KC4USP reported that two Navy aircraft returning to Christchurch, New Zealand due to bad weather, were short of fuel and unlikely to make their destination. Due to abnormal radio conditions, Palmer Station was unable to make radio contact with Christchurch. W6AJZ responded to a call for help and was requested to phone Commander Osborne, Miami, Florida, and have him notify Christchurch by commercial communications that both aircraft were attempting alternate landing at Dunedin, New Zealand. It was urgently required that this airport implement emergency conditions including turning on all landing lights, field lights and adjacent city lighting to guide the troubled aircraft.

Apprised of the situation, Commander Osborne contacted Washington. Telephone contact with W6AJZ was then transferred to Captain Price-Lewis in Washington, where communications were already established with Christchurch. For the next 45 minutes all communications between Palmer Station and Washington/Christchurch were relayed via W6AJZ.

During this period Palmer reported radio contact had been lost with one of the aircraft. The aircraft's last known position was relayed to Washington and Christchurch. The commanding officer of Palmer Station declared a May-Day status.

Captain Lewis reported, for relay to Palmer, that all required emergency measures had been implemented at Dunedin Airport, and that air-sea rescue facilities on the South Island had been alerted. At 7:50 PST, with all emergency preparations in New Zealand confirmed by Captain Lewis, emergency radio contact with KC4USP and landline to Washington was secured.

Later that day Captain Lewis telephoned W6AJZ to advise that both aircraft had landed safely. A letter of March 3 from the National Science Foundation confirmed the safe return of the two Navy LC-130 transport aircraft with the assist of amateur radio communications.

CANADIAN NEWS

Courtesy of Canadian Amateur Radio Federation

Banned Countries List: Cyprus (amateur operations suspended except for operation on special occasions when call sign 5B4 will be used and communication with other countries is permitted), Gabon, Iraq, Khmer Republic (formerly Cambodia), Libya, Pakistan, Turkey, Yemen (Peoples Democratic Republic - formerly Southern Yemen) and Viet-Nam.

Third Party Traffic Agreements: Amateurs of Canada may exchange Third Party communications with the amateurs of the following countries: Bolivia, Chile, Costa Rica, Dominican Republic, El Salvador, Honduras, Israel, Mexico, Peru, U.S.A. (Territories and Possessions), Venezuela. Effective 12 March 1972: Trinidad and Tobago.

Reciprocal Licensing Agreements: All Commonwealth countries are eligible for reciprocal amateur operating privileges unless evidence that a country does not grant reciprocal operating privileges to Canadian amateurs. Canada also recognizes such agreements with the following countries: Belgium, Dominica, Dominican Republic, Ecuador, France, Fed. Rep. of Germany, Israel, Luxembourg, Mexico Netherlands, Nicaragua, Norway, Peru, Portugal, Rep. of Panama, Senegal, Sweden, Switzerland, U.S.A., Uruguay, and Venezuela.

SKYLARC PROPOSAL TURNED DOWN

The following letter was received recently from NASA concerning AMSAT's proposal to provide a ten-meter amateur station for NASA's SKYLAB manned orbiting laboratory scheduled for flight in 1973:

Dear Mr. Klein:

As you know, the AMSAT proposal to provide a radio amateur communications package for leisure time use by the crew on Skylab has been the subject of serious consideration within the Skylab Program for some time now, and more recently, by the top management of NASA.

It is with real regret that I must inform you that in spite of the broad appeal of your concept and a generally favorable disposition to encourage AMSAT activities, NASA has concluded that we cannot add it to Skylab at this stage of the program; and, therefore, we must reject your proposal.

The decision involved many factors difficult to summarize briefly, including concerns for the priority of this proposal relative to other program additions that are also under consideration, the funds for the necessary integration and testing, and concerns for even a small additional diversion of management and engineering attention at a critical time in an extremely complicated program.

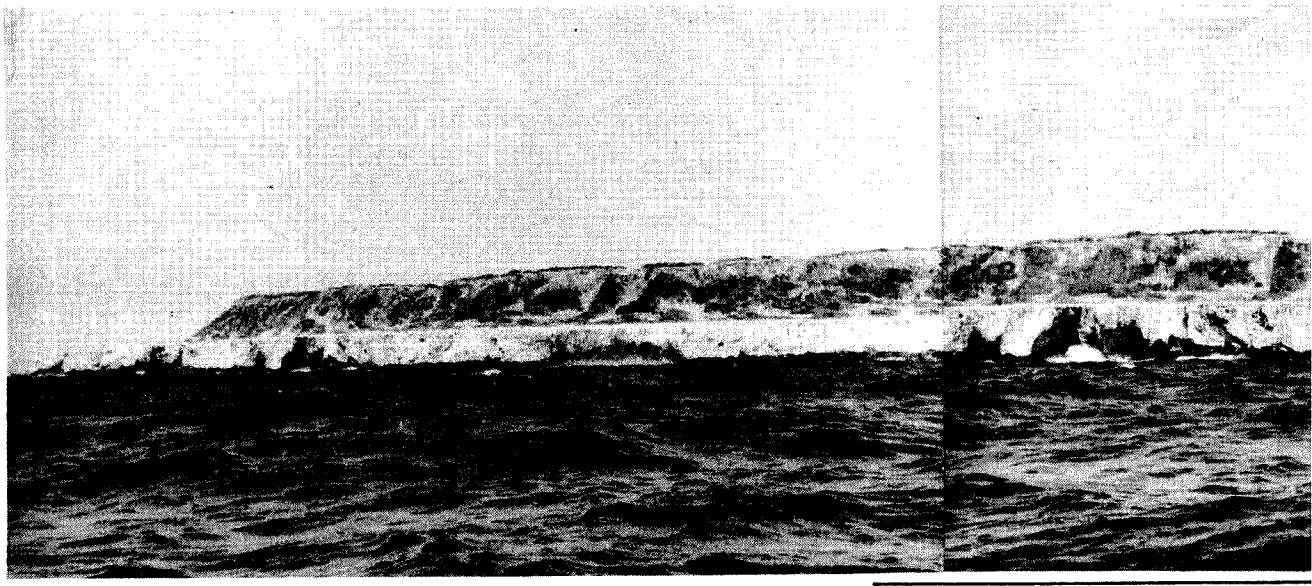
Our conclusion was not an easy one to reach. Considered by itself the proposal appeared feasible and reasonable - one that we could not reject out of hand. It may be of some solace to you that I brought the subject to the attention of Dr. Fletcher (NASA Administrator) and Dr. Low (Deputy Administrator) because of the uniqueness of the proposal and that the final decision was made by them, and then only with reluctance.

Should you desire, Mr. William Schneider, Director, Skylab Program, would be pleased to give you a more complete debriefing on our decision.

Sincerely,

Dale D. Myers
Associated Administrator
for Manned Space Flight

Reprinted from AMSAT Newsletter



73 GOES TO NAVASSA

One of the rarer spots in the world of the DXer is a little deserted island in the Caribbean not far from the stronghold of Papa Doc Junior . . . indeed the island, though it actually belongs to the United States, is claimed by Haiti. This erstwhile German prison island has been off-limits to everyone up until just recently, ever since the late 50's.

A group of Atlanta amateurs have organized an expedition to put Navassa on the air for three days in mid-May and have asked Editor-Publisher Wayne Green W2NSD to join the group. Permission has been obtained from the Coast Guard and the FCC has issued a special events call for the trip of KC4DX. The last call assigned for Navassa was issued to Wayne back in 1958 and was KC4AF. Wayne and five other amateurs visited the island at that time and in four days of around the clock operating rendered it un-rare for DXers.

You may be sure that the DXers will be reading the details of this exciting trip in 73, where it will be reported in full.

It is hoped that financial support will be obtained for a professional film of the expedition. Dave Bell, who produced the Hams Wide World film is interested in the project, and at least two major manufacturers have indicated an interest in the film.



Landing site at Navassa.

CW AWARD

To promote CW activity on six meters, Dennis McCormack, K1PLX, is awarding a special certificate to stations that work ten or more stations on CW or MCW. This is a great way for Technicians to improve their code while preparing for the General Class exam. Why not have a certificate that shows you operate this fun mode? It is a nice sign of accomplishment for anyone who operates six meters. The award is available for only a quarter in stamps, IRC, or cash from D. McCormack, K1PLX, $$2, Box 329, Salem NH 03079. There are eleven different types of endorsements too.

General Bulletins for RTTY Ops

Call	Freq.	Shift	Day	Time	QTH
PAØAA	3600	850 Hz	Friday	2030Z	Sassenheim Holland
	14100				
	145.14				
W1AW	3625	1st copy	Monday	0300	Newington CT
	7095	850 Hz	Tuesday	2130	
	14095		Wednesday	2300	
	21095	2nd copy	Thursday	2130	
	28095	170 Hz	Friday	0300	
			Saturday	0300	
DL8CX	3585	850 Hz	Sunday	1030	Hamburg, West Germany
	3585	170 Hz	Wednesday	1800	

FLASH!

New OSCAR 6 Development

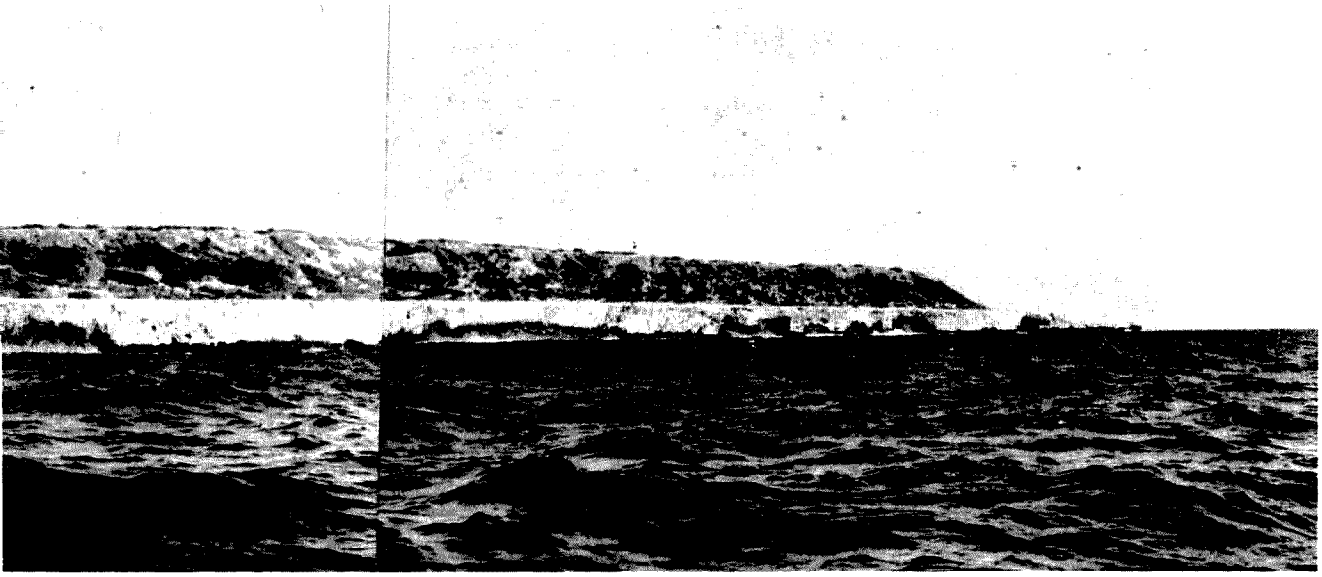
AMSAT has just announced that the OSCAR 6 active relay satellite 2 to 10 meter translator would operate in the non-inverting frequency mode. The launch is scheduled for July. The input transponder frequency range on 2 meters is from 145.90 to 146.00 MHz. The transponder output on 10 meters is from 29.45 to 29.55 MHz. The exact 10 meter output frequency can be calculated by subtracting 116.45 MHz from the 2 meter input frequency. Of course the output frequency can be plus or minus about .7 kHz due to Doppler shift on both the input and output frequencies. Manual 10 meter receiver tracking will be necessary on all modes except FM where AFC or a Phase locked Loop detector can be utilized. An example of the frequency translation is that if OSCAR 6 receives a 145.950 MHz input signal on 2 meters then the translator output frequency on 10 meters would be 29.500 MHz plus or minus the combined 2 and 10 meter Doppler shifts.

Horizontal linear polarization will be used on both the 2 and 10 meter antennas on the OSCAR 6 satellite.

SCHOLARSHIP ANNOUNCED

The Foundation for Amateur Radio, Inc., announces the annual award of the John Gore Memorial Scholarship for either graduate or undergraduate study. The Scholarship pays $500 for the academic year. Upon re-application, it is subject to being renewed for succeeding years.

Licensed radio amateurs who intend making a career in electronics or related sciences may now request the application for the academis year 1972–1973. Requests should be addressed to the Chairman, Scholarship Committee, 8101 Hampden Lane, Bethesda, Maryland, 20014. Requests for applications must be postmarked prior to May 31, 1972.



OBSERVATIONS ON THE SPACE CONFERENCE

Gary Allsman, W5UEW

Recently I had the opportunity to observe the amateur radio fraternity and one facet of its work from a position that not many of us from the hinterland, West Texas, often have the opportunity to do. I was fortunate to be in a position to take part in the preparation for and participate in the 1971 World Administrative Radio Conference for Space Telecommunications, WARC-ST, held this last summer in Geneva and thought the following comments would be appropriate on the eve of the A-O-C launch:

The Amateur-Satellite Service came out fairly well at the WARC-ST but things could have been better. And as one might expect, favorable amateur influence in a large number of delegations could have been greater.

The IARU, with AMSAT providing technical support, was present as official observers and carried the ball for the amateur community so far as on scene support was concerned. The IARU was highly respected by all delegations and provided a strong and necessary favorable influence for amateur matters at the Conference. (As a side light, some organization like the IARU must be on hand as a politically neutral source of information; often information from national delegations is looked upon as colored by national interests.)

But IARU presence at the Conference was not enough. A large majority of delegations come to a conference with a predetermined opinion on matters involving policy or politics in contrast to matters involving technical trade-offs. Amateur radio unfortunately often falls in the former category. This means the amateurs in each country must work to convince their own telecommunications officials to look favorably toward amateur matters before a conference begins. At a WARC each country has one vote and the favorable vote of just 8 or 9 additional countries at the Conference could have resulted in additional allocations for the Amateur-Satellite Service.

There is insufficient space here to try to categorize the various reasons why an administration comes to a conference with preconceived negative positions toward amateur radio. In a few smaller countries however these negative positions are often based on one or two negative encounters with individual amateurs or sometimes just a complete misunderstanding of what amateur radio really means and tries to do.

The activities of AMSAT provide new opportunities to educate high officials and provide favorable public relations. Possibly the glamour of space will open new doors and we can swing the telecommunications authorities in more countries around to see the advantages of making all aspects of amateur radio available to their citizens.

Reprinted from AMSAT Newsletter.

CW DX MOBILE

Congratulations to W6AM, Don, who has worked 176 countries from his mobile station during normal to and from work driving, about one hour per day average. He runs 1 KW on CW in the mobile.

Courtesy of the Hamrag

BIRMINGHAMFEST

The "Birminghamfest" this year will be on Sunday, May 7, at the Exhibition Hall at the Alabama State Fairgrounds near Five Points West in Birmingham. For entertainment, prizes, contests, net meetings, eyeball QSO's and fun for the entire family, plan to attend. For further information contact the Birmingham Amateur Radio Club, W4CUE, P.O. Box 603, Birmingham AL 35201.

WHERE IT'S AT!

SSTV FREQUENCIES

3.845
14.230
21.360
28.680

RTTY FREQUENCIES

3.625
7.095
14.075 autostart
14.095
21.095
28.095
146.70 (AFSK)

ARRL CODE PRACTICE AND BULLETIN FREQUENCIES (MHz)

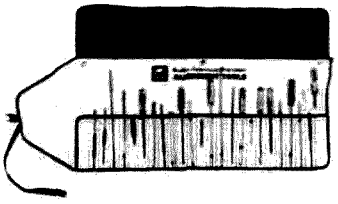
1.805
3.580
7.080
14.080
21.080
28.080
50.080
145.588

ARRL PHONE BULLETIN FREQUENCIES (MHz)

1.820
3.990
7.290
14.290
21.390
28.590
145.588

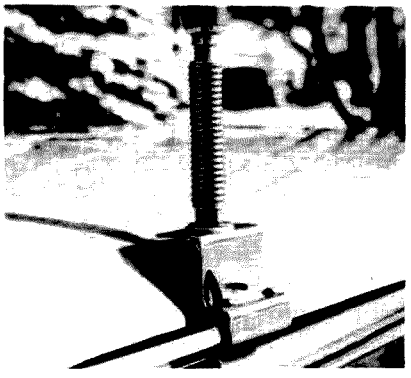
NEW PRODUCTS

New Alignment Tool Set



FMers and hams who just cannot find the right alignment tool now can keep all of these valuable instruments in one place. Jensen Tools and Alloys has come frequencies involved. Most receivers use interchangeable 45 MHz crystals, the tools for ham and other communications services. All are insulated and they include a long-reach core aligner, i-f transformer aligner, some special TV aligning rods, slotted tip, recessed tip, and hex style tips are all included. The pouch rolls up neatly and folds over so the tools can never fall out to be stepped on and broken. Under $17, it is available from *Jensen Tools and Alloys, 4117 N. 44th St., Phoenix AZ 85018.*

Mobile Antenna Gutter Mount



Here's new convenience in a rugged, all stainless mobile antenna gutter mount. The unit installs quickly with only a screw driver, is self-grounding and no holes are required in the auto body. Surprising signal results are received using a small spring and resonator only mounted on the 3/8-24 stud – no mast section is required. Also, it is easy to reach out the window and pull down the antenna for garages and other obstructions.

Add a small protective strip under the clamp screws and the bracket becomes a very strong trunk lid mount! When used with small transceivers (cigarette lighter plug-in) you can be mobiling in any car or truck in a very few minutes.

Priced at $7.95, it is available from *Rejsa Engineering Co., 7632 Plymouth Ave. N., Minneapolis, MN 55427.* (Spring, resonator and coax not included.)

REPEATER UPDATE

LISTENING
94 76 88 73 70 64 82. . .

AL	W4QEE	Mobile	22–82
AL	WB4QGL	Montgomery	34–94
AL	W4MWF	Montgomery	16–76
AK	KL7USA	Anchorage	34–94
CO		Denver (RTTY)	10–70
CT	WA1JTB	Bridgeport	146.295–146.895
DE	K3SVA (now WA3KWE)		
IA	WA0SNS	Waterloo T2.1	34–94
IL	WB9ADW	Genoa	13–73
IL	WA9LIV	Waukegan	145.75–146.55
IL	WB9INC	Hinsdale T2.0 (formerly WB9HWS)	73–01
KY	W4YWH	Highland Heights	19–79
MA	W1EMB	Everett PL 88.5	13–73
MA	K1AIU	Framington	change to 146.55–147.15
MA	K1UZR	Bellingham	146.46–147.06
MD	W3IJK	Frederick	13–73
MI	WA5RMS	Gautier	28–88
MN	W0GKP	Duluth	34–94
MO	WA0ZIK	Eldon	28–88
NY		Brooklyn	146.205–146.805
OH	WB8CQK	Dayton	16–76
PA	WA3NOF	Lancaster	01–61
FOREIGN			
Canada			
	VE1AEH	Mt. Blomidon (N.S.)	146.58–147.18
	VE1HI	Charlottetown (PEI)	34–94

Thanks to W4CNQ, WB9ADW, K1SOP/KR6, W1HBH, K1AIU, K1MON, WA9AFM/0, VE1SH, WB9HWS, W3IJF, WA2HVK, W3FEY, WA5RMS, WN0BAV, K3NOQ.

LETTERS

I wholeheartedly agree with the idea of using 146.52 as a simplex channel and will do all I can to promote 52 as suggested.

Ron WA1PMS
Arrow Electronics
Norwalk CT

Following is a letter to the editor of the LIMARC Log:

Dear Ed:

On Thursday, Jan. 13, I was in Dayton Ohio with my TR-22 and I had the pleasure of participating in a ham radio function that was unique in my (too many) years of experience. I think LIMARC could benefit from the approach the Miami Valley Amateur Radio Club takes in using and policing their impressive repeater system.

At exactly 7:30 a net control stations signs on 146.76 (I understand they're changing to 146.64, but that's beside the point). He solicits check-in's and just logs calls as fast as he can. He announces that this is a regular meeting of the club, that each check-in will have a chance to be heard and after a brief "business" meeting there will be a technical talk by one of the members.

By 7:40 thirty amateurs had checked in, including W2NM. Net control then solicited comments from each check-in in the order they checked in. Comments ranged from complaints about rag-chewing (and a restatement of the club policy regarding same – they discourage rag chews on the repeater) to quality of signals and very brief descriptions of equipment that individual members wanted to get rid of. Such offers were followed by a brief pause, and in almost all cases arrangements were made for "land line" contacts to discuss details.

When it came my turn one of the members broke in and asked me to tell them about New York repeater operations. They were impressed and very interested. You should have heard the groans when I gave them the LIMARC frequencies. They were also surprised to learn that there was no useful 34/76 repeater in the New York area.

After a very brief business session, certain committees reporting (such as an apparently effective crystal acquisition committee) one of the members spoke on receiver trouble-shooting. He was most enlightening, and he let the repeater drop periodically for questions – which were frequent and very intelligent.

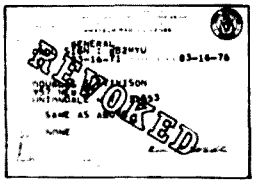
The technical talk was followed by a general roundtable and some pleasant yakking.

So an excellent meeting was held, information exchanged, club policy restated, equipment exchanged, etc., and nobody left the comfort of his home! (By the way it was snowing and very cold.)

You might consider a similar operation for LIMARC. It works!

Jim Fahnestock W1NM

WITH THE FCC



The Fiscal Year 1970 FCC Report includes a comment that 2491 violation notices were issued aginst hams, as compared to 2464 in 1969. One percent of the American ham population is not bad, but it should not be that high. Many notices were due to lower class licensees operating in band segments reserved for higher class licenses. The Citizens Radio Service had 1409 notices in 1970 as compared to 2400 in 1969. There seems to be little effort to catch illegal CBers or else it is very difficult to identify people who do not give any identification. It is unknown at this time what proportion of the ham violation notices led to further FCC action as compared to those of the Citizens Band.



To mark the 75th anniversary of the Marconi Kemp Tests of 1897, the Barry College of Further Education Radio Society is issuing an award, in the form of a certificate, to radio amateurs who provide proof of contact with Commemorative Stations, established in various parts of the world, and amateur radio stations in Italy and Britain.The award will be made available to amateurs and short wave listeners for a period of approximately 12 months, starting on May 13, 1972 with the establishment of the Bristol Channel Commemorative stations at Lavernock Point, Flatholm Island and Brean Down, and ending May 31, 1973. All questions and comments should be addressed to the Awards Committee, Barry College of Further Education Radio Society, College of Further Education, Colcot Road, Barry, Glamorgan, England.

* * *

The Lockheed Amateur Radio Club again sponsors the biggest annual ham convention in the Los Angeles area. The date this year is May 20 from 10 A.M. until 8 P.M. There will be an interesting program and prize drawings and a good time for all. The site will be at the Lockheed plant in Burbank, seven blocks east of the Hollywood-Burbank Airport.

* * *

The Baton Rouge ARC will hold its Eighth Annual Hamfest May 6 and 7 at Father Colbert's Camp, just east of Baton Rouge. Besides the Hospitality Room and evening awards banquet, there will be a Swap-Fest on Sunday, contests for high speed code, home brew building, and a demonstration of radio control airplane flying. On Sunday there will also be a giant picnic featuring Uton Diez, the world's "Champion Jambalaya Cooker."

* * *

The Rock River Radio Club will hold its annual hamfest on May 28 at the Lee County 4-H Center in Amboy IL. The indoor all-day event begins at 8 A.M. Free coffee and donuts will be served while you inspect the gear at the tables. Free camping area nearby. For further information, contact Carl Carlson, P.O. Box 99, Nachusa IL 61057.

The Wabash County Amateur Radio Club will hold its fourth annual hamfest at the Wabash County 4-H Fairgrounds, Wabash, Indiana, on Sunday, May 21, rain or shine. Admission is only $1. There will be no set-up charge for the flea market. Activities include technical talks, free Bingo for the XYL's, and door prizes. Free parking. Camping is available on the grounds Saturday night. For more information write Bob Mitting, 663 N. Spring St., Wabash, IN 46992.

* * *

The Maryland Mobileer Amateur Radio Club will sponsor a Hamfest on Sunday, May 21, at Anne Arundel Community College, starting at 10 A.M The college is 6 miles north of Annapolis, just east of Route 2. Talk-in on 7255 kHz, 146.94 and 146.16/76 MHz starting at 8 A.M. Plenty of parking; lots of goodies. For further information contact Donna Fournier, Secy. MMARC, R. 1, Box 154, Discus Mill Road, Severn MD 21144.

* * *

USAF MARS Region 1 Convention will be held at the Statler-Hilton Hotel, Boston, Mass. on 19, 20 and 21 May. Lectures, demonstrations, exhibits, forums, eyeball QSO's, social events and a banquet highlight the affair. All interested radio amateurs are encouraged to attend. Contact WA1PBJ, John Donovan, 19 Pratts Junction Road, Lancaster RFD, MA 01523 for tickets and information.

* * *

The P.H.D. Amateur Radio Association will sponsor the third annual Northwest Missouri Hamfest to be held at Claycomo, Missouri on Sunday, May 7, 1972, from 9:30 A.M. till 4:30 P.M. The location will be in the U.A.W. hall across from the Claycomo Ford Plant on U.S. Highway 69 Alternate. This event draws the most active amateur radio operators from the states of Kansas, Nebraska, Iowa and Missouri.

* * *

The Annual Humboldt Amateur Radio Club Hamfest will be held Sunday afternoon, May 21, at the Shady Acres City Park, Trenton, Tenn. There will be door prizes, flea market, ladies' activities, and a playground for the children. For further information contact W4IGW, Edgar Holmes, 501 N. 18th Ave., Humboldt, TN 38343.

* * *

Free code and theory classes for ham licenses are held every Wednesday night at 8 P.M. at Land of Electronics, 400 South Main St., Lombard IL. Call Phil, K9DTB, for info (312) 495-1234.

The 39th annual Western New York Hamfest and VHF conference will be held in Rochester, N.Y. the weekend of May 12–13.

Activities start Friday, May 12th at the Rowntowner Motor Inn, 800 Jefferson Road (14623), new Hamfest headquarters.

Registration for this fabulous day is only $3. Combined registration and banquet in advance is only $7. Advance sale closes May 6. There will be only a very limited number of banquet tickets available at the gate. Write: WNY Hamfest, Box 1388, Rochester, N.Y. 14603.

The New York Chapter of the National Awards Hunters Club offers several awards for working various proportions of New York State hams. For more information about these certificates, write to Joseph Tricarico, WA2MWO, 338 Madison Ave., West Hempstead NY 11552.

Worked New Brunswick Counties Award

This award requires QSL cards from twelve counties of New Brunswick, each showing county, date, band, frequency, mode, and operator's name. Send cards to H. W. Gammon, VE1PM, 357 St. Andrews St., Bathurst, N.B., Canada.

PENNSYLVANIA

The annual Presque Isle Amateur Radio Club banquet will be held May 20, 1972 at the Concord Inn at North East PA. Social hour will be from 6:30 to 8 P.M. Dinner will be served at 8 P.M. The price is $5.00 per person. For more info write PARC, P.O. Box 1021, Erie PA or call AC 814 866-0491.

On May 21st, the Breezeshooters Eighteenth Annual Hamfest will be held at White Swan Park near Pittsburgh. This is the largest ham gathering of its kind in the area. Contact K3FGQ for more info.

* * *

The Sharon ARA will be holding a ham auction on Saturday, May 20, at the QTH of WA1LXE. The auction will begin at 1 P.M. Directions available by writing to Dave Fisher WA1LXE, 30 Ames Court, Sharon, Mass.

* * *

The Yellow Thunder ARC will hold its annual hamfest on May 27 at the Dellview Hotel, Lake Welton WI. For further information, contact Al Gallagher WB9BPL, 401 Market St., Lodi WI 53555.



EDITORIAL BY WAYNE GREEN

SCANNING GREEN

While some of the chaps on slow scan television have built their own monitors and cameras, and some have gone the EKY Video Vision kit route, most of the ops have gone first class with the Robot monitor and camera systems.

Imagine the chagrin of the chap who has spent nearly a kilobuck and finds he is now able to see Wayne Green making faces.

The Robot monitor and camera arrived the other day and everything else ground to a halt. Within a couple of hours the mating plugs had been made up and we were on the air with slow scan television.

The connections are simple . . . the monitor plugs into the regular mike input of the rig and the mike then plugs into the monitor so you can talk normally or switch over to sending pictures. The audio for the monitor is picked up off the speaker of the receiver. The camera plugs into the monitor and you're ready to go.

The first day on television we made do with signs propped in front of the camera which were produced with a broad black felt pen. The very first QSO was with W6IFL and Pete helped us adjust the contrast and brightness controls on the camera. Next came KL7HEE, then HK5HK and HK5BFK, KH6DEH . . . etc. All of these were what is called "closed circuit" . . . the pictures came in just as if they were from our own camera.

The next day we broke from work for a few minutes to see what might be coming in from Europe . . . ho, ho . . . HA7LF . . . not closed circuit with all that afternoon QRM, but perfectly readable. Mel W8UUS, an old friend of ours of twenty years standing, swapped pictures . . . then W1PFA from over in the eastern sector of New Hampshire for state number three. Bill's demo of the Robot system at a recent K1MNS repeater group meeting was one of the last straws that pushed us over the hill into getting on slow scan. You can talk about it and read about it, but until you see it you can manage to ignore it.

When Bill discovered that we were on SSTV he sent over a menu board for us to use. This is a black board with white plastic letters that can be stuck on in moments. With this contraption we are able to put the call letters of the station we are contacting up on it and make an instant on the air QSL. We rigged up the board to say, "Hi 4X4VB QSL de W2NSD/1 New Ham Shire 20 MAR 72, WAYNE – 73." All we do is change the call and show a few frames of this to QSL each contact. It becomes a CQ call by setting up a CQ in place of the DX call and QSL.

Once you start seeing the pictures of the fellows you are contacting you realize there is a lot of truth in the proverb about the difference between a man and a boy being the cost of his toys. But what a toy! On the second day of viewing we swapped pictures with VK5MF and three I's . . . then came the DX contest and all bets were off for the weekend of intense QRM Oh well, we did pick up a long "needed" FM7 contact during the contest for an extra country . . . we're around 300 now somewhere on 20 phone.

Day by day the slow scan countries and states are building up . . . the main problem is an almost total lack of time to operate. We can get in a few short contacts on FM from the car while taking Sage to the day care center or while going downtown shopping, but we don't have the repeater connected to the 20m rig yet so we're stuck down on 2m via W1ALE in Concord to a cross band on 6m. There is precious little activity on 52.525 except when the band is open and we can work W4's by the gross via the repeater. Other than that the main attraction is K1IIG down in Hartford who has a 450 repeater with output on 52.525.

We're up to 20 countries on slow scan, despite the limited time . . . perhaps an hour every other day. The latest was 4X4VB, our first Asian QSO . . . leaving only Africa for WAC. Since ARRL seems to have refused to provide an SSTV endorsement for their WAS and WAC certificates, it seems likely that 73 will try to plug this hole in the dike. There are some active African SSTVers, so WAC should come shortly.

What can you say about the excitement of sitting there watching live pictures from a DX station? Or from a friend you haven't seen for a while. The pictures are remarkably good, considering the limitations of the medium. In order to get the bandwidth down to ham band proportions it is necessary to effect some small economies here and there. A regular television pictures requires about 4,000 kHz bandwidth. In order to shoehorn this big thing into the 20m phone band we have to prune it by sending somewhat fewer pictures a second and fewer lines per picture. Fast scan runs 60 pictures per second . . . so if we chop that down to one every 8 seconds we have about 1/500th as many pictures to send per second . . . a dandy saving. If we cut the number of lines from 440 down to 120 we have cut another 1/4 . . . a total of about 1/2000th as much information per second . . . or about 2 kHz bandwidth instead of 4 MHz.

With pictures taking 8 seconds you have to hold still when you are shooting it "live."

Many of the ops are using the Robot monitor for receiving and using tape recorded signals for sending pictures. Robot will make up tapes for you . . . and so will any owner of a camera, so it is no big problem. Buster W9WED takes his cassette recorder along mobile and makes two-way slow scan contacts all with his recorder, sending his pictures from one cassette and recording the incoming pictures on another cassette. He then plays the tape into his monitor when he gets home and there are the pictures. He has several countries and a bunch of states worked two way mobile slow scan already.

There are at least 45 countries on slow scan for W8YEK has worked that many. You'll find a list of these contacts in the slow scan column this month.

ADDITIONS TO 73 STAFF

Yvette Grimes (WA8ULU (we all ate Uncle Louie's Underwear) has joined the crew at 73 as Assistant Publisher, an omnibus category which entails producing the 73 books and hypoing subscriptions among a long list of lesser duties.

Yvette is getting out several interesting books, including one on How To Use FM, written by W2NSD/1, a book of digital control circuits for repeaters, a book on slow scan television, one on converting commercial FM equipment, a book on 432 MHz construction projects, a transistor project book, and many, many others. She has her hands full.

Lin Green, wife of the publisher, has taken on the thankless job of Advertising Manager. This job involves an almost unlimited amount of details, the missing of any of which will probably result in the total alienation of at least one advertiser. Keeping the ads for eighty or so advertisers in each

issue of 73 plus those in the Repeater Bulletin all in order is a tough job.

Ed Webb W4FQM has signed on as Technical Editor of 73. Ed brings considerable design experience in solid state and IC's. Ed has considerable experience in RTTY, FM, SSTV and several other areas of the hobby. Watch for a lot more IC project material in 73.

HAM CELEBRITIES

W2NSD/1

Some amateurs are so starved for a celebrity to hound off the air that they will even tackle W2NSD/1.

Seriously, would you like to hear King Hussein on the air more often? Would you like to hear Arthur Godfrey around the bands? How about Barry Goldwater? Andy Devine? These fellows . . . and more . . . will be active and on our bands if only you will let them.

Put the shoe on the other foot for a moment. How long would you stay active on the bands if every time you gave your call you were forced off the air with breakers? Would you continue to ham if you found an enormous pileup every time you stood by? Would you enjoy the hobby at all if there was virtually no way to complete a contact? And if you get mad and complain then you are a bad guy

The next time you hear someone well known on the air why not just enjoy listening to him . . . or her? Help them to enjoy amateur radio so they will be with us longer. Jordon is certainly not rare anymore, so why not let King Hussein make some contacts without immediately jamming him right off the air as soon as you hear him? You lose . . . he loses . . . we all lose. The other evening I heard JY1 make a contact with someone he knew . . . and as soon as it was over the screams of anguished amateurs demanding a contact were heard nonstop for about ten minutes. One W4 called over 200 times! And he already had worked JY1, I remember working him from there.

We will have friends if we deserve them. Please, the next time you hear this nonsense going on, take the time to go on frequency and explain to the mob that they are helping to make life miserable for someone who should be a friend of amateur radio.

IS 220 MHz REALLY LOST?

The EIA seems to have its propaganda mills cranking out garbage full blast, perhaps even straining the almost inexhaustable coffers of the assorted unscrupulous manufacturers who are dreaming of a $500 million a year market if they can just get that band away from the hams.

The EIA lobby in Washington is totally unopposed by any organized amateur radio effort to save the band since we have no Washington lobby of our own. The EIA seems to be encouraging the manufacturers with pie in the sky promises of great golden rewards . . . just imagine the profits if one out of every ten new cars sold (10 million cars) had a $200 CB transceiver! That's $200 million a year!!! Then one out of two of those would buy a base station too . . . and add in business use for doctors, plumbers, salesmen, farmers, etc., and you have $500 million a year . . . yum.

The EIA seems to have managed to get the Defense Department to okay the deal, leaving it squarely up to the FCC. The FCC could hardly be less enthusiastic – and no wonder – they are at wits end with the present citizens band and the prospect of unleashing a new screaming mess of CBers hobbying away with illegal calls, illegal power, illegal antennas, and illegal language gives them the whim-whams. Can the FCC withstand the one-way pressure?

Can anything be done to save this amateur band? Is it really worth any serious effort to save? After all, it is virtually unused today, so why make any big deal out of it?

It may come as a shock to low banders, but the most used amateur band today, by far, is the two meter band. Over one third of the active amateurs in the U.S. are on two meters! You can't say that about any other band. In many areas of the country the top half of two meters is virtually filled . . . and in the case of New York, overfilled. The congestion there is a harbinger of what is to come for the rest of the country in perhaps another year or so.

Where do we go next when two meters is full? We go to 220, that's where. What about 450? This band is a lot fuller right now than you think . . . what with television using the lower third of the band, weak signal ops using the center third and FM repeaters and control links using the top third. There is room for expansion on 450, but not a whole lot in urban centers. No, we need 220 . . . we need it now . . . and we will need it desperately in another couple of years unless FM growth suddenly stops . .. and there is no reason to expect anything but continued growth of FM since it is one of the biggest bunches of fun amateur radio has ever provided.

I am convinced that 220 MHz can be saved for amateurs . . . and saved in its entirety. I believe that we have the thinking part of the FCC on our side and that if we give them any reasonable excuse for saying no to the manufacturers that they will indeed say no.

Time is short .. . painfully short. If we dawdle for a few more months there will be no way to save the band. The way to save it is the obvious one . . . use it. Use it or lose it, a good slogan and an accurate one. So how can we use it . . . in a hurry?

The prospects of much more AM or sideband operation on 220 are not encouraging . . . but more FM would be simple and could be quickly organized. If every repeater group in the country made it a crash program to put on a 220 repeater . . . NOW . . . we could have somewhere between 500 and 1000 repeaters on 220 MHz by fall . . . and I think, if we could do that, we would have ourselves an amateur band and no great big CB mess.

This plan was unfolded before the representatives of about 50 northeastern repeaters at the Shrewsbury FM Symposium in February and every single two meter repeater group agreed to put on a 220 signal as quickly as possible. The first on were the WA1NXG repeaters in Connecticut, with both WA1KGQ in Vernon and WA1KHA in Torrington going on full 220 repeat in early March! Bruce and the group are to be congratulated!

The big holdup for large scale integration of 220 is obviously the lack of equipment. There is little available in quantity for the band. This is being corrected, thank heavens. Ed Clegg has announced that he will soon have a 220 transceiver available . . . plus a 220 repeater package. TPL, which sells through Henry Radio as Tempo, will be making deliveries of their long-awaited 220 transceiver ($179) and that should get things moving. This is an AM-FM rig, for both crystal and vfo use. TPL is also working on a 220 repeater package which is expected to be priced at about $300. Look for 220 gear from Avcom, Standard, SBE and others before long. By fall the rush to use 220 may be on in earnest . . . perhaps we can save this one. You may be sure that every piece of 220 gear that comes out will be reported in depth in 73.

Credit where it is due: the ARRL filed a comprehensive comment with the FCC supporting the amateur need for the 220 band and pointing out the reasons why CB use of the frequencies would be to the advantage of no one except a few manufacturers.

The future of 220 MHz is up to you. Members of repeater groups should raise cain until a 220 transmitter (at the least) is put on. Please be sure to let me know when you get on the air so your transmitter can be listed and the FCC can be advised of your use of the band.

What channels to use on this band? The northeastern repeater groups decided, after a lot of hassling, to run all

(continued on page 10)

W2NSD *continued from page 9*

repeater inputs starting at 221.98 and going down every 120 kHz for each succeeding channel. The outputs would be 3 MHz above that, starting down from 224.98 MHz. Narrow band, please. The coordinator for the northeastern part of the country for this band (and all the other FM bands) is Pierre Catala F2BO/W1, 180 Maple Street, Needham MA 02192. As soon as coordinators are available or known for other parts of the country I will pass along their addresses.

THE SON OF 160m

Amateurs of my vintage can remember with great warmth the old 160 meter band, back when it ran from 1800-2050 kHz for phone and was the very best band we had. It was great for local and relatively short distance contacts and it was nice and wide . . . for those days. The other two major phone bands were restricted to Class A amateurs and were each only 100 kHz wide, and were each just about permanently filled with a handful of smug kilowatt nets . . . it only took nine of them to fill up each band.

The FCC tells us that it should not be long before that dratted Loran is removed from 160 and the band can again be turned over to amateur use. It's about time . . . Loran has been bypassed technologically for quite some time and has just been hanging on and on and on.

Say . . . perhaps you'd better pass along a note to your favorite manufacturer and let him know that it might be prudent to add one more position on the band switch of future models . . . and calibration for 160m. This will be one hellova band when it gets going again. You wait and see.

ROLLING OFF A LOG

About 75% of the FCC complaints against amateur have to do with the keeping of logs. This has nothing to do with any directives from Washington, but seems more to represent initiative on the part of a few engineers in charge of FCC monitoring stations. One is inclined to wonder why these chaps are not spending their idle hours trying to stem the flow of obscenity and linears on 11 meters instead of harassing amateurs over a regulation that is of utterly no importance today. Other than the fact that logs have "always" been required, what possible reason is there for keeping them? Logging has been done away with for many services, yet just because it still stands on the books for amateurs some engineers are making life absolutely miserable for quite a number of amateurs.

SSTV SCENE

SSTV reminds one of the early days of SSB. Remember when there were only a few SSB'ers, and they gathered on specific frequencies? Remember when DX stations first started appearing on SSB; the "Quacking;" the "Different type" pileups? The resemblance between the start of SSB and the start of SSTV is phenomenal. If this is any indication of things to come, SSTV may grow to be as popular, or more popular than SSB. And why not? Commercial TV replaced radio to a large extent, did it not? Soon "just talking" to a guy will be a mode of the past. Each day more and more of us are getting to see, for the first time, the fellows we've been talking with in the past. And believe me, that's quite a surprise. As the XYL, WB4OEE, said the first time she saw W7ABW, "But that's not how he sounds like he would look." Indeed, very few people do sound like they look. It's just that you don't notice it if you meet them in person. Sound interesting? Right on! Maybe I've enticed you to at least investigate slow scan TV. Chances are you'll find it the most fascinating aspect of ham radio since the spark gap.

The 1972 slow scan contest activity appeared heavier than last year, and band conditions were very good. There should be some high scores this year. One couldn't help but notice the way EA8CI was picking off QSO's on 20 meters. And 15 meters was usually good for a few more countries. There was a definite trend this year to the use of white lettering on a black background for ID's that seemingly punched through QRM. And I never heard last year's winner, W9NTP, on at all. Don?.

Recently while working one of the SSTV gang, the question of power and final tube life came up. I was quite surprised to find the other station was running around 600 watts average output on SSTV, while I was running 50 watts output, average, on SSTV. Our pictures were closed circuit both ways. He was also having trouble with short final tube life under these circumstances. While I watched, he reduced output down to 50 watts. His signal dropped from around 20 over 9 to about S9. The pictures were still perfect copy.

This brings to focus an important point newcomers may not know. The use of reduced power is proper in slow scan TV. Since the 1200 Hertz carrier is constant, the duty cycle is 100%, the same as leaving a constant carrier on the air. Modern rigs can withstand this punishment only a few seconds; thus cutting back power output is the logical answer. Granted, 50 watts may be an extreme on low power and 600 watts may be an extreme on high power, but I think you get the point. The least power necessary to maintain a solid copy QSO is usually much less than you suspect. Most of the old time SSTV'ers who have a KW linear run 150 to 200 watts on SSTV, and have found these conditions a happy medium between tube life, signal strength, and QRMing others. A little experimentation on your part will show you your best power for your rig. And remember, reduce output power by decreasing mike gain and camera or tape recorder output, not by loading the amplifier lighter or (gad) by dropping the linear and putting a super heavy load on the poor exciter. Remember – let the rig and linear loaf along!

It's good to see exotic DX and celebrities on slow scan. 9K2AM, 9Q5BG and others keep the boys hopping on 20, and Barry Goldwater, K7UGA/WA7UGA had some good pictures for the slow scan net (14.230 MHz, 1800 GMT, Saturdays) last Saturday. He was 20 over 9 here in Birmingham, Alabama. Now if we can get the boys to move the camera off Barry and show us around that fabulous station of his!

I hope I'm not letting the cat out of the bag, but – the plumbicon tube can be used directly on slow scan – no expensive fast scan and sampling techniques involved. The tubes are difficult to find (TV station pullouts are the only way) but once you've secured one – WOW! More info on this will be available later.

Some of the gang are getting quite a few countries on slow scan now. Who's the W8 with 40 plus countries? W4MS and VE7JA are in the high thirties – no telling how many W9NTP has – I'm still plodding in the mid-thirties. How about you? Drop me a card and tell me your SSTV total, and maybe a good off-the-air photo you'd like to show in this column. Or, tell us about your special SSTV project you've been working on. It will be quicker to send mail to me directly, rather than through the

73 would appreciate getting a copy of any correspondence you may have received from an FCC engineer regarding logs. Perhaps, by making the names of these chaps public we can discourage them from pursuing this vendetta against hams.

Mind you, we don't in any way condone illegal amateur operation . . . over power, stuff like that . . . but we do want to try and protect individual amateurs against harassment, from any source.

. . .Wayne

73 office. My address is: *Dave Ingram K4TWJ, Eastwood Village #50N, Rt. 11, Box 499, Birmingham, Alabama 35210.*

Here is a list of some active DX stations using SSTV, thanks to W8YEK, who worked them. Look for them:

CT1PG	IS1GF	VE6RM
DJ0CN	KH6DEH	VK5MF
EA4DT	KL7DRZ	VP9GR
EA8CI	KP4GN	W4MS
EL2CB	KX6DR	XE3DX
F6AXT	LA3SG	XW8AX
FG7XT	LU7AAG	YN3RBD
G5ZT	OK1GW	ZL1AOY
GW3DZJ	ON4DN	ZS3B
HA7LF	OZ4IP	ZS6UR
HB9IT	PA0LAM	4M2BC
HK7X1	PY2EEG	4X4VB
HR3HH	PZ1DA	GY5PB
I1LCF	SM4AMM	9K2AM
	SV1AB	9Q5BG

Following is a suggested signal reporting system for use on SSTV:

R S-V

R = Voice readability 1 - 5

S = Signal strength 1 - 9

V = Video readability 1 - 5

V0 = Nothing decipherable

V1 = Occasional letters come through, difficult to copy

V2 = Call sign readable, pictures visible, if not identifiable

V3 = Good copy on some pictures, occasional complete pictures

V4 = Good copy most of the time, photos recognizable, some interference, multi-path fading etc.

V5 = Solid closed circuit pictures

That's it for now. See you on SSTV.

K4TWJ



Worked all Mass. Cities & Towns Contest, 0001 GMT June 11 to 0400 GMT June 15. This is a maximum of 100 hours. Exchange: Signal report, City (or Town), County, and State. Scoring: One point for each Massachusetts station worked regardless of band. Final score is the number of different Mass. stations times the number of different incorporated Mass. Cities & Towns worked. Operators may enter as single band or multi-band stations. A certificate will be issued to the winner in each State, Province, and Country in each class. In case of ties, the entry having worked the most Counties shall have the higher position. Entries must be received no later than July 31, 1972. Entries must show date and time of Mass. stations worked plus the "exchange" information. Submit entries to Warren Baker W1DFR, 66 Rexford St., Mattapan MA 02126.

6 METER

THE FIFTY MEGAHERTZ BAND

W4GDS, known to many for his daring exploits as ZF1RS during several previous VHF contests, is planning to go even further afield this year. Bob has already been issued the call VP5RS and if everything gels as expected he will be active from Cacios Island for several days around contest time. Cacios, in case you don't know, is one of a group of islands located approximately 500 miles southeast of Miami and 175 miles north of Port-Au-Prince. Tentative plans call for a beacon which would be operative even if the band isn't open. Details will be published as they become available. By the way, Bob, do you really think you can get United to stop there?

While on the subject of DXpeditions it might be well to mention that the people who undertake these trips for our pleasure do so at their own expense and often require (and always appreciate) an SASE. The same is true of Stateside operators who live in sparsely populated States. The burden of postage on hundreds of cards each year is too much to bear. You can make life easier for these people and insure receiving a QSL by doing this small courtesy.

The annual VHF Conference of the Central States VHF Society is scheduled for the weekend of August 18-19-20. Now is the time to start making plans to attend. The society net meets at 2130 CST on or about 3980 kHz on Sunday evenings. Give a listen - you will hear a great deal of interest to the VHF-UHF devotee.

The near complete silence has been broken! The evening of March 5th brought a rather extensive opening from 7 Land as far east as the third call area. Glen WA7FPO, could be heard working Missouri, Kansas, Oklahoma and Tennessee, among others. The 5's in Texas and Oklahoma also got their share working into Florida and most of the Midwest. A report was received to the effect that the border states had earlier in the day heard signals from Central and South America; however the report has not been confirmed as of this writing.

In building several dozen KW PEP linears of the type described in the July 1969 issue of 73, a number of changes were made which may be of interest to those planning a similar project. The chassis size was changed to 8 x 10 x 2½ in. in order to allow the same amplifier to fit either the Swan or Heath speaker cabinet. Components originally mounted on the side of the chassis were moved underneath maintaining the same relative position. Each screen is now fed through a separate No. 327 lamp and bypassed by a 13K, 10W resistor. The resistor biases the lamp on so that less screen current is required to blow the bulb. It may be necessary to adjust values in the screen supply to compensate for the additional current. With this modification it is no longer necessary to change one tube at a time in order to determine which of the parallel pair is defective. The amplifier will run quieter if you tack the chimneys to the sockets with 3 or 4 dots of silicon rubber bathtub caulk. It stops the inevitable chattering.

WA0ABI

HOT GEAR

Joseph A. Gibson K1TLP, 181 So. Orchard St., Wallingford CT 06492, reports the theft of a Standard SR-C806 FM Transceiver, S/n 009210; also 25 watt power booster. $50.00 reward for information leading to arrest.

Aerotone Model 6M 355LT, S/N 685064, Penn Central RR Police, Rm 1750, Grand Central Terminal, 15 Vanderbilt Ave, NY NY 10017.

Std. SRC-806M S/N 102703, Clem Mathias, 3134 Coronado Ave., Imperial Beach CA 92032.

Lafayette HA-410 S/N 10014, Ger. Macari WA2KDG, 29 Carriage Dr., Kings Park NY 11754.

List from Past Issues:

Mfr., Model, Ser. No.	Owner	Issue
Halli, SR46A, No.446100	WA1EMU	9/71
Reg., HR-2, No.04-03505	WA5BNM	11/71
Sonar, FM3601, No.1003	WB2ARM	11/71
Coll., 75A4, No.804	W0MGI	12/71
GE, Portable, No.1041218	K2AOQ	1/72
Coll., 75SE-B, No.15640	Col.St.U.	1/72
Coll, 21S3, No.12000	Col.St.U.	1/72
Coll., 516F1,No.1649	Col.St.U.	1/72
Simp. Mod-A, No.35457	W2PWG	1/72
SBE SB-33 No.103906	WA5JGU	2/72
Heath HW22A No.907-1835	W1BDX	2/72
Nat'l HR050 No.280019	WA5DQF	2/72
Halli., SR160 No.416000-108039	K9YVA	2/72
Drake TR3 No.3858	WA9EYL	2/72
Coll., KWM2A No 13815	ARRL HQ M. Godwin	2/72
Coll., 312B4 No.59920		
Coll., 30L1 No. 40084		
Coll. MPL No. 44507		
Coll. MM1 (mob. mike)		
Misco minispkr.	Sgt. Hopkins Wilm. DE Police	2/72
Swan SW174 No. 416-5	W0AXT	2/72
Reg. HR2A No.04-05896	K4GBL	2/72
HR2A, No.04-6208	W8FXX/5	3/72
Heath SB102,No.132-128107	W.Singer Woodbridge VA 703,491-2257	3/72
Yaesu FT-101 No. 107036	WA2YSW	4/72
Standard 2m FM No. 102703	W6NPV	4/72
Drake ML2 No. 20189	WB2LLR	4/72

Microwaves

Go away, appliance operators! This column is written for those amateurs enterprising (and foolhardy) enough to populate the amateur bands 1 GHz (1000 MHz) and above. Believe me, there is darned little commercial amateur gear up here.

So, for those who have what it takes to venture into black magic land via this column, let's lay some ground rules for the care and reading of the new microwave bulletin board.

This column belongs to you, the experimenter and microwave communicator. Any topic you wish clarified, any product you want the world to know about, and especially any news you may have to share with your fellow microwavers – all it takes is a postcard. This column can't exist without inputs from *all* of you.

1 GHz (1000 MHz) will be considered the "normal" lower cutoff frequency of interest, but an occasional venture to 450 will be made.

Waveguide & Widgets (New Products)

Fairchild reportedly has a 25¢ computer diode oscillating in the Trapatt and Impatt modes. The diode is the FD-300, and several people report powers (pulsed Trapatt) of several *hundred* watts around 500 MHz. CW Impatt oscillations around 3 or 4 GHz (no power level given) with this device has also been noted. For more information, see February 1972 issue of IEEE – "Transactions on Microwave Theory and Techniques (MTT)."

Thinking about next Christmas for your least-liked friend? Give him some new 15 GHz (yes, that's right, 15,000 MHz) ARSENIC transistors. The arsenic doping allows emitter regions to have a 1 micron (1/1,000,000 meter) width. The arsenic also allows you to create a pretty spectacular whodunit. This is more completely described in *Microwave Journal* February 1972, or write to Fairchild Semiconductor, Palo Alto CA.

Above the noise

Pete W6DXJ, Carl WA6RGH and Jim WB6BHI, have claimed a new amateur S-band (2300 MHz) record. It seems Pete and Carl had the first amateur phased-array (one-way) contact; Carl and Jim had the first phased-array to phased-array (two-way) contact, all over a closed 100 meter course. More information on this is being prepared for publication.

Microwave mumbo-jumbo

You may have a question or two about frequency designations in the microwave region. This one is typical:

What is "S" band and why is it so named?

It started a long time ago when scientists were inventing radar. Radar, by the way, was classified "Top Secret" during WWII. Even the name radar was "TS." Naturally, the frequency used was secret also, and what is more secret than "X."

So they called the old radar band (10 GHz) X-band. After the war, when things loosened up a bit, they began experimenting (mostly amateur experimentation – at that time we had all bands 10 GHz and above) with other frequencies. The old radar terminology stuck, and they began naming other bands apparently at random.

Herewith a tabulation of the letter bands:

Letter	Frequency Band	Amateur Band
P	200–400 MHz	220–225
L	400–1500 MHz	420–450
		1215–1300
S	1.5–40 GHZ	2300–2450
	1500–4000	3500–3700
C	4.0–6.0 GHz	5.65–5.925
X	6–12 GHz	10.0–10.5
K	12–36 GHz	21–22
		All above 30
Q	36–46 GHz	All
V	46–56 GHz	All
W	56–100 GHz	All

Thus, to speak of amateur "S" band, either 2.3–2.45 GHz or 3.5–3.7 GHz is the band in question. To distinguish, the terms "High S" or "Low S" are used to determine a particular band.

Amateur High S = 3.5–3.7 GHz.

Amateur Low S = 2.3–2.45 GHz.

Jim Weir, WB6BHI

Military Affiliate Radio System

MARS is made up of licensed hams who are interested in military radio communications. Separate programs are operated by the three services, all using similar rules. Any licensed amateur, sixteen or older, who has a station capable of operating on the assigned MARS frequencies (usually just outside the regular ham bands) may apply to the service of his or her choice for MARS membership. To apply, simply write for a MARS application to one of the following:

ARMY: Room 1C475, The Pentagon, Washington DC 20315.

AIR FORCE: Bldg. H243, Tempo E, 4th & Adams Dr. NW, Washington DC 20333.

NAVY-MARINE CORPS: 5827 Columbia Pike, Bailey's Crossroads VA 22041.

"Okay," you say, "I know how to get into MARS, but why should I join and what do I do after I get in?" The answer is complex – first, you take your place with a growing number of active hams who are getting invaluable training in military communications – who serve as an immediately available auxiliary communications system for the Armed Forces in the event of an emergency – and who handle countless thousands of morale-building messages and phone patches for our servicemen overseas. As an active MARS member you will be eligible for certain surplus equipment – some so sophisticated as to be beyond the reach of the average ham, and you will be eligible for correspondence courses from the various Armed Forces Schools and Institutes – courses that will take you from the basics through space technology, and at no cost! This column is not to be construed as a sales pitch for MARS – just the facts. More on responsibilities and benefits in future MARS columns.

Welcome to new Chief MARS Army, Col.(Ret.) Robert B. Woodside A3ZLH, who is a long-time active MARS member and former Maryland State Director. Acting Chief Joseph Ziglinski A4DIN, will remain as Assistant. Congratulations to A3ECP, another long-time Maryland State MARS Director, who was awarded the Army's Oustanding Civilian Service Medal . . . First Army has a code proficiency program, 4001.5 kHz, on the second Sunday of each month at 6:30 PM EST.

The State of Virginia is covered completely with a 2 meter MARS network, and plans are underway to link the entire First Army Area from Maine to Virginia! Repeater inputs are on 148.01, out on 143.99 as in most Army installations. MARS members from other Army areas are welcome to use these facilities when in the First Army area, according to Command MARS Director Bob Sheridan, and the same policy has been placed in effect by Third Army MARS Director Hal Mulkey and Fifth Army MARS Director Roland Belk. Perhaps by the time you read this the Sixth Army will have joined in the "reciprocal trade treaty!" Meanwhile, if you are a MARS member traveling in a different Army area, don't hesitate to use the facilities – the worst thing that could happen is for someone to tell you you are not authorized for that area – something that happened to no less a personage than Acting Chief MARS Army A4DIN!

* * *

Director A3EGN reports the installation of Delaware's first Army MARS 2 meter repeater. A1W, Southern New England Army MARS Director announces their spring meeting will be held at Natick, Mass., on either the 13th, 20th or 27th of April – check

locally if you plan to attend. Their first repeater will be installed at Ridgefield soon. The first New Jersey Army MARS repeater is being installed, just in time for the spring membership meeting at Fort Dix, and the spring dinner-dance at Fort Monmouth (you thought MARS was all work, huh?). A2BVE reports that New York, New Jersey and Pennsylvania held a very successful combined emergency drill on 6 February.

* * *

Congratulations to Air Force MARS – they have *35 repeaters* working in their Northern Communications Area! This includes 6 in Pennsylvania, 5 in New York, others in DC, Virginia, Connecticut, Rhode Island, etc.

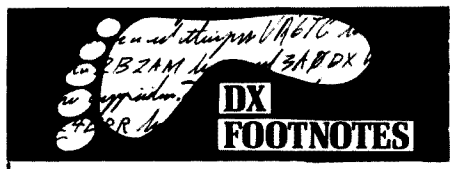
Armed Forces Day is Saturday, 20 May – the annual opportunity for hams to work crossband with MARS HQ stations WAR, AIR, NSS and NPG, using all modes. In addition there is a 25 wpm code proficiency test and a 60 wpm RTT test and all contacts are acknowledged by colorful one-time QSL cards. The activity starts at 10 AM EDT and runs until 1045 PM EDT. Frequencies are too umerous to mention here, but look for the HQ stations just outside either end of 80, 40, 20 and 15 – they will announce what frequencies they are monitoring.

The 15th Annual Third Army MARS Conference will be held at Fort McPherson, Georgia, near Atlanta, ith over 600 members and guests, on 14 and 15 April. In addition to the riter's wife AL4ECK, other important personages will include Maj. Gen. eorge Pickett, Jr., A4DIN Acting hief MARS Army and Roland Belk, Fifth Army MARS Director. You are nvited to visit with us and watch the op brass hobnobbing with the parking lot attendants, doctors, farmers, etc.

Other meetings: Texas Army MARS 13 and 14 May, El Tropicana Motor Hotel, San Antonio – New Mexico State MARS 20 and 21 May in l Paso, Texas (Bet there's a story here!) – Missouri Army MARS was eld 8 and 9 April – Louisiana 15 and 16 April – Wisconsin 22 and 23 April, ansas 29 and 30 April – Arkansas on 6 and 7 May. Consult your local irector for detailed information.

WAR is NCS for a new nationwide raining net on 6977.5 kHz, seven ays per week, 8:30 AM EST until 10 PM EST. All Army MARS members are invited to check into this net when possible.

Harry Simpson A4SCF
P.O.Box 27015
Memphis TN 38127



If you are planning to visit Mexico and wish to operate from there, write for a permit to operate. Send to: Liga Mexicana Radio Experimentandores, AC Malinos, 51307 & 8, Mexico 19, D.F., Mexico. Do not contact the Mexican government directly. (Thanks to BCARA)

RYUKYU ISLANDS

The Ryukyu Islands will revert to the control of the Government of Japan effective 1501 GMT, 14 May 72 (001 hours, 15 May 72, Okinawa/Japan time).

Effective with reversion of the Ryukyu Islands to the Government of Japan, the amateur radio call sign prefix KR6 will no longer be authorized for use by U.S. Forces personnel stationed in the Ryukyu Islands. The call sign prefix KA6 has been authorized for these personnel effective with reversion.

In addition, third party traffic, phone patch/message, will no longer be authorized to or from the Ryukyu Islands as they will be under the administration of the Government of Japan which prohibits this type of traffic.

* * *

All cards for WB4FWV, WA7MEA, DL4EQ, PA9FJ, HS2JR, HS2ACA & YBØAAW should go to DK1RR.

* * *

As of 1500 hours GMT, 14 May 1972, the KR6 prefix will terminate and will be replaced by KA6.

* * *

The Okinawa Amateur Radio Club (OARC) will change its title to Okinawa Radio Club (ORC). QSL cards may be sent via the KA6 QSL Bureau, Okinawa Radio Club, Ft. Buckner, APO 96331, San Francisco, California. QSLs sent to this address are limited to members of the radio club. Prior to sending a QSL card, you should determine by asking whether you should send direct or via the bureau. Request has been submitted to ARRL for the Ryukyu Islands to remain a separate country for DX purposes. We have also been informed there will be no third party traffic either to or from KA6.

* * *

Countries that share reciprocal operating agreements with the U.S.: Argentina, Australia, Austria, Barbados, Belgium, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Finland, France (and possessions) Fed. Rep. Germany, Guatemala, Buyana, Honduras, India, Indonesia, Ireland, Israel, Jamaica, Kuwait, Luxembourg, Monaco, Netherlands (and possessions), New Zealand, Nicaragua, Norway, Panama, Paraguay, Peru, Portugal, Sierra Leone, Sweden, Switzerland, Trinidad & Tobago, UK (and possessions), Uruguay, and Venezuela.

* * *

Third Party Message Agreements: Argentina, Barbados (U.S. stations operating /8P), Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Greenland (XP calls only), Haiti, Honduras, Israel, Liberia, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, and Venezuela.

* * *

From MARCO Bulletin

In September of 1971, there was a change in Japanese law, permitting use of amateur stations by Americans; however, due to the complexity of the procedures, there have been almost no cases of this system being used. It is almost impossible for a foreigner to operate an amateur station in Japan. Thus the plan of letting foreigners use club stations was devised. If a foreigner is registered as a member of a club consisting mainly of Japanese, he can operate the amateur station. It's just that call signs cannot be issued to foreigners as individuals. A case in point: U.S. Ambassador to Japan, Armin H. "Hank" Meyer and Mr. Alfred C. Roussean, who was in Kyushu for a short stay, were aware of this. The call signs were W3ACE/JH1YDR and W1FJJ/JA6YAO respectively.

* * *

From MARCO Bulletin

SSTV DIRECTORY TO BE PUBLISHED

Robot Research Inc., is preparing a world-wide directory of active amateur radio slow scanners. A statement appears in their brochure calling for amateur radio operators who are active in the operation to file their names and call letters. In return they will send a free copy of the directory when the calls are in and compiled. Write to: *Robot Research, Inc., 7591 Convoy Ct., San Diego CA 92111.*

QSL INFORMATION

GM5AXO via S. G. Hawley, Box 265, U.S. Navsecgruact, FPO N.Y. 09518 or QSL to WA4UAZ. DX may QSL via RSGB.

9Y4EH, Robin Rampersad, 1402 Regent St., #672, Madison WI 53711 or via Rampersad, 51 Moody-Stuart St., San-Fernando, Trinidad Stobago W.I.

LETTERS



"You have made my day!"
George K3QHY

In the mid 1930's we, W9PRH, W9STT and W9UJC, lived within a block of each other in Bismarck, North Dakota. As time we on each moved away and we lost track of one another. W9PRH eventually ended up in California. W9STT also was in California (Los Angeles). W9UJC moved to Billings, Montana. W9PRH let his call and license expire, W9STT became W6WKY, W9UJC became W7FKW. W6WKY and W7FKW established written communications and kept in touch by Christmas cards and notes over the years. In January 1970 W6WKY and W7FKW got together on the air and made a sked for the next day. During the QSO that followed we got to reminiscing about old times and friends and our travels. We were talking about ex-W9PRH and wondered what had happend to him.

Unknown to us was the fact that ex-W9PRH had moved to San Pedro, California, and had purchased a used receiver, had it on and was listening on the same same band and frequency and heard us talking about him. He got our addresses from a Call Book and wrote to us. We were amazed and surprised to hear from him. What a coincidence that he should hear us! As a result ex-W9PRH got re-interested in ham radio, boned up and got his ticket: WA6AYA. The three of us have had skeds on Sunday for some time. W6WKY and WA6AYA had an eyeball during the summer of 1971 and in Feburary 1972 the three of us had an eyeball at the home of W6WKY at his Los Angeles QTH. What are the odds on something like this happening?

M. Hansen W6WKY
Los Angeles CA

About 3 to 1.

Please put me on the 73 subscription list. $6 is enclosed. Keep up the emphasis on FM. Also please put me on the Repeater Bulletin mailing list. (I use K1FFK). I hope to work you soon through FFK. I'd like to see an article also, on a moderately priced homebrew or otherwise synthesizer.

I'd like to see an FM contest — maybe number of stations worked with a repeater multiplier and a multiplier for handy talkies. Some way, though, the repeater should be kept open for non-contest use. I disagree about shifting the National XCVE frequency from 94/94. We have two repeaters here that have 94 outputs (K2AE and WB2NNZ) plus direct activity as well and because of the capture effect things seem to work out fine. In fact there is an advantage as direct people can talk to many mobiles who are one channelers either NNZ (34/94) or AE (46/94).

One more thing. I cast a yea vote for 10 meter repeater links. I'd also like to see a sideband link for 15. How about output on 21.445 to stay away from DXing and other non-repeater activities.

Jon Soffer WA2LXI
Albany NY

The consensus re FM contests is yeccch.

You talked about someone on two meter FM working DX through a link and I heard it today. Operating on 2 meter FM with 1 watt WB8AGZ/OE9 was working through OE9JKI/mobile OE9 to OE9AHI who was working on 25 meters to a W8 in Michigan. The copy was 100%, S9+ both ways. It was so good that I listened instead of getting the tape recorder on line to make a tape. The only thing that could have been better was for the WB8 to be on skis not in his warm-up boots.

Jim Kirkgasser WA2ELA
Dewitt NY

Looks like Austria's getting ahead of us.

ERRATA

In your Feb. 1972 73 Magazine I noticed an error in your "Tuning Mr. Morse's Key" article. The photos on pages 17 and 18 of holding the manual key and bug paddles have reversed captions. Check and you will see!

Peter E. Brown WA2PTW

That's not a bug paddle, it is a keyer paddle.

Morse Memory — Revisited

As a result of several letters and my own review of the Morse Memory (*73* December 1971), I have reviewed the article and the following corrections should be made:

1. In Fig. 1 an arrow is missing from the Memory Address to the Memory.

2. In Fig. 2, the Q output of A6 should be pin 6.

3. In Fig. 2 there should be switches shown from the four A1 gates.

4. In Fig. 2 the CS siwtches at the very top must have the unused terminal on each switch connected to +5.

5. There are a couple of discrepancies between Fig. 6 and Fig. 2. A7 (Fig.2) is not shown in Fig. 6. A7 (Fig. 6) is the 8 input NAND gate in Fig. 2. The 10K resistor in A5 (Fig. 6) should go to pin 9. Pin 13 of A3 (Fig. 6) should be DATA 1.

6. Now for Fig. 5: the −9 volt supply is obviously wrong. I built it with the bridge reversed and Q3 is PNP. Instead of the GE xstr for Q3 a 2N408 would be appropriate. Also T3 should be marked 12.6 volts.

I'm sorry for the inconvenience this caused the many people who wrote to me, and the many more who didn't. The Morse Memory does work. Good luck.

Hal, WA6ATT

How about more articles on 6 meter FM & SSB operation. 2m has been fully exploited. For heaven's sake, keep us posted on FCC rulings on FM repeater operation! Much needed around here!

Mike, K7LYK
Seattle WA

POPULATION GROWTH

The purpose of this letter is to set forth an idea for increasing the annual number of hams. It won't require any action by the FCC, but it will evidently require a change of spirit in many of us.

Actually it is quite simple. If, since the day you became a ham, you have not yet been directly responsible for at least one new face in our hobby, then promise yourself, make a resolution, that you are going to get at least one interested person into the hobby this year (perhaps sort of as passing along the help you got when you were starting). Give that person help with the understanding that he (or she) will do the same tning in a few years.

So far, it is evident that this has not been done. While there were something like 17,000 new amateurs last year, this figure would have been about 50% larger if just ONE-TENTH of us in the U.S. had made the above resolution. Perhaps the lack of people who like to train new hams is due to the fact that many of us haven't tried it yet, don't think we're qualified, or don't think we have the time. Well, if you haven't tried it, why not try? If you don't think you are qualified, how did you pass the exam? If you

can't spare about 45 minutes per week for a few weeks, are you dead or something? Actually, all I'm trying to say is that helping someone else into a hobby that you know is really great is one of the most rewarding things you can do in ham radio.

In case anyone wonders what I've done recently, I've graduated a total of 90 new hams from 3 classes in 3 years. Age here is 18.

Just try it once this year, and see what a great feeling you get when that guy shows you the QSL from his first QSO.

John Kittler WA9ZXU
Rock Island ILL

That's great, John. We should do everything we can to promote interest in ham radio. I recently received a letter from a young person who wanted to become a ham and asked the assistance of an old timer. The OT said he didn't have time. With an attitude like that, it's easy to see why so many kids get into CB. Ham radio has so much more to offer. Boy Scouts need merit badge advisors. High schools sometimes have hobby shows. Maybe your club can operate Field Day on the town common while a few members explain what is happening and why. There are hundreds of ways to involve others in ham radio. We owe it to each other to do it. Now.

KIND WORDS

I'm a Junior at ISU and have been away from 73 and ham radio for several years.

I'm happy to be getting back to both now. I just thought I'd take time out from studying for final exams to tell you how pleased I am with 73.

Mark Lund WAØRAO
Ames, Iowa

Hey, if you run into WØLR, who hates 73, say HI!

I just received my first issue of 73 which I can call my own and almost immediately got a friend of mine to subscribe. It sells itself and is much better for someone with QueSTions than another mag put out by someone else.

Seriously, I think that the idea for 2 meter repeaters is great, but the manager of this station, whose call letters I would rather not have printed, says that a tech signal may not be repeated into the upper class segments of the band. Would you please clarify this for me?

Name withheld by request

Once everyone has this clarified, repeater growth will sky-rocket. The apartment dweller without the ability to set up outdoor antennas will soon be able to be repeated around the world while he sits at home with a little ground plane hanging from the ceiling. Techs can be repeated into other bands under the correct licensing procedures.

I don't like the new look of 2 meters (FM, crystals, "CB like" etc.) and it was my only VHF operation about 3–4 years ago. Thank God 80m CW hasn't changed. I subscribe to no ham mags now. 73 will be the only one.

W. R. Meador WA8TRB
Niles Michigan

The fastest growing aspect of ham radio obviously has a bit to recommend it. Try it – you'll like it.

I like to read 73 and wouldn't miss an issue. I have been here in Texas two weeks and a few of us are putting up a repeater in nearby Wichita Falls with 34–94 facilities. It will be open, carrier operated, and a Touchtone autopatch planned. There is no call letter for it yet.

Don Fraser WA9WVS

34–94 repeater #543 being planned.

I have been slogging through mud and snow down to the local electronics store every month to buy your stupid rag since issue No. 1. The proprietor laughs in my face each time I pick my copy of 73 off the shelf and occasionally sics his dog on me as I leave. NO MORE! I refuse to be made a fool of. 'Tis time my mailman, a professional slogger, earned his keep by delivering that stupid, atrocious, unauthorized, irreverent, unofficial nothing you so flippantly call a magazine. Enclosed you will find my subscription. Hah! Now who's stupid?

Walter A. Miller WA9BUN
Park Ridge, Illinois

It's abooouuutt time.

I recently completed three terms as SCM of Georgia and am a loyal league member for nearly forty years. I have not always agreed with your views regarding the league, nor have I always been in sympathy with the attitude of the league. In fact my split feelings prompted me not to offer for reelection and to discontinue league activity although I remain a member in order to have the right to voice my opinions.

Howard L. Schonher W4RZL
Columbus, Georgia

The only one who agrees with Wayne all the time is Wayne, and even then . . .

Thanks for an excellent issue on CW. You can t be as one-sided as anti-FM'ers think you are, if CW made the front page. In all sincerity, 73 is still as different from the other three to keep me a subscriber.

W6GMD/7

CW and FM were just subterfuges. SSTV is the only way to go.

Got a huge charge out of our brief SSTV QSO this AM! It will certainly do no harm to SSTV to have one our our most outspoken editors "seen" regularly! (Won't hurt 73 a bit, either!)

You may not recall, but almost two years ago you forwarded my request for help to Ted Cohen W4VMF. Ted was extremely helpful, guiding me along the not-too-well-trodden trail to successful SSTV operation. I had built the K7YZZ scanner and had the very great pleasure of a 2-way QSO with Lou himself during my first attempts at pic transmission. Also worked Ted finally.

I am slowly converting to solid state and adding a Plumbicon camera. It is only through this activity that I have had the opportunity to learn anything about digital and linear IC's.

Please keep a ready supply of such info on hand for future articles, even if they may be somewhat redundant in basic topic.

Availability of IC's at low cost, including op-amps, balanced modulators, PLL's etc., are all resulting in a re-emergence of the true "ham," the experimenter, innovator, developer and TEACHER!

Lee Clough W5GQV
Waco TX

STUDY GUIDES

Allow me to congratulate you on helping me pass my Extra theory exam. The series you ran in 73 was most helpful and rather painless. I have had success with others using your General series, also.

Jefferson Junior High of Champaign has a ham radio club which was formed last spring. I am their sponsor and teach Math and Science there for seventh grade.

William B. Vokac K9WQY
Mansfield, IL

It's sure good the way you fellows get info in one place and in a form even one as nontechnical as I can "dig." Good? It's great!

Sara A. Thompson
Houston, TX

KUDOS & QUERY

This is just a short note to make several points. The first is I enjoyed the February 1972 issue more than any since I started reading 73 two years ago. The QRP projects are probably the best way to go for those who wish to put some zip back in their operating time and get into the home-brew game.

The second point is that I believe the manner in which you have organized your journal, monthly topics, is very useful. The ideas in one article reinforce those in another, which at the same time serves to generate new ideas and approaches to a subject.

And now my third point. Do you think you could prevail on the Tempo people to come out with some information on the new 2m AM/FM transceiver you discussed in an editorial in the fall and that was advertised in the November 1971 issue? I would like to know when they intend to market it

(continued on page 16)

Caveat Emptor?

Price – $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor . . .

SUPPORT ARHA – YOUR VOICE IN Washington – the "other" national ham organization. Get expanded privileges for Technicians and Novice phone. Box 123, Syracuse, N.Y. 13210.

2-METER FM INOUE IC-10, Brand New, 1 & 10 watts, solid state, 12 channel, w/Xtals, w/accessories $249.50. Bob Brunkow 206-747-8421, 15112 S.E. 44th, Bellevue, Washington 98006.

FIGHT TVI with the R.S.O. Loss Pass Filter. See p115, March 1972, 73. Write for brochure. Taylor Communications Manufacturing Company, Box 126, Agincourt, Ontario, Canada.

STANDARD 826M, just like new, used only for review in 73. 12 channels, Mosfet receiver (hot!), 10 watts output. Sells for $340 new, first check for $295 takes it away. Make check to 73 Magazine, Peterborough NH 03458.

FOR SALE. Ross & White 1972 model FM transceiver with 12 channels and 3 frequency tone burst built in by the factory. Loudspeaker on front panel for best audio results. S-meter, hot front end, protected rf transistors, all crystals easily changed and trimmed, 0.1 1.0 and 10 watt output, mechanical filter for selectivity, 6 IC's in one of the most modern circuits yet produced. This transceiver sells for $405 with the 1800, 1950 and 2100 Hz tone burst. The first check for $350 will get this unit, brand new, used only for tests at 73 HQ. 73 Magazine, Peterborough NH 03458.

SECORE TEST EQUIP – New in Original Box GC-159 Color Gen $125, GC-161 Color Tube Tester $100, MU-150 Tube Tester $200. R.A. Coburn, RFD 2, Tinkham Lane, Londonderry NH 03053.

TEN TEC PM2C rig (has 15m). Excellent, in box, $35.00. Shure 405K mobile 10-4 Mic $10.00. K6OVN, Harold Hasbrouck, 1157 Palms, Venice CA 90291.

SB 102. AC supply, DC supply, mobile mount, mobile antenna, speaker, mike. Check or M.O. $450. James Tyler, 5309 Euclid, Lawton OK. Tel 405 248-0024.

TYPETRONICS needs your excess unused Teletype parts, M.14 to M.37. Write description and asking price to Typetronics, Box 887, Ft. Lauderdale FL 33310. W4NYF. Sell, too!

TO SETTLE ESTATE OF W6NIT – SB110A with HP23A $150.00. HQ170C $120.00. H010 monitor scope $40.00. S.A.S.E. for various other equip. & instruments. Contact A.A Trumble, 1311 So. Glendale Ave., Glendale CA 91205. 123-242-0718.

2–G.E. FM TRANSCEIVERS Transistorized Progress Line. 12 volt, 15 watts, fully transistorized receiver and power supply. Front mount. 1 unit converted for 2M other in commercial band. Swap for HT-200, PT-300 or sell $149. WB6CDU, 8302 Rathburn, Northridge CA 91324.

MARINE ELECTRONIC EQUIPMENT – Make money in your spare time. Sell V.H.F., RADAR, and all types of marine gear. Send for details RAD-COM INC. Mamaroneck NY 10543.

BE PATIENT! Only 170 days left before the gala opening of the Hudson Division Convention! Exhibits, Lectures, 2-meter FM, RTTY, Contests, Gabfests, New York Sightseeing, Fun. Free gift for each early registrant. Oct. 21–22. Hilton Motor Inn, Tarrytown, N.Y. Info from Dave Popkin WA2CCF, 303 Tenafly Road, Englewood NJ 07631. Worth waiting for!

HOOSIER ELECTRONICS. Your ham headquarters in the heart of the Midwest where only the finest amateur equipment is sold. Authorized dealers for Drake, Regency, Hy-Gain, Ten-Tec, Galaxy, Rohn-Spaulding, Electro-Voice, and Shure. All equipment new and fully guaranteed. Write today for our low quote and try our personal, friendly Hoosier service. Hoosier Electronics, Dept. D., R.R. 25, Box 403, Terre Haute, Indiana 47802.

WANTED – Model 28 teleprinter. Also HF-receiver, converter etc. for reception RTTY weather broadcasts. E.B. Buxton, Consulting Meteorologist, Box 322, Morrisville, Vermont 05661. 802-888-4566.

WARREN ARA'S FAMOUS HAMFEST, now family style, Aug. 20, Yankee Lake, Ohio. Gigantic flea market, swimming, picnicking, playground, all free. Camping available. Details: QSL W8VTD.

NEW ELAPSED TIME METERS 110V *50* cycles $5.00 each; PL-259 coax connectors 7 for $2.00. Plus Postage. Bill Hayward, 1307 NE 57th Terr., Gladstone, Missouri 64118.

BUYING? SELLING? TRADING? Don't make a move until you've seen our new publication. Free sample copy! Six issues $1. HAM ADS, P.O. BOX 46-653Q, L.A., Cal. 90046.

73 MAGAZINE: Complete collection except January 1961 issue. From October 1960 to October 1971. All issues mint condition. Best offer. Allan Weaver, 1921 Clinton, Aurora, CO 80010.

LETTERS CONT.

and would like more information on it. We still have a fair amount of AM 2m activity (in addition to the repeaters in the areas) in central Connecticut. Therefore it would be an ideal rig for this neck of the woods.

David J. Norden W1GDM

As information on the AM/FM rig becomes available we will pass it along n 73. It might be helpful to understand that the Tempo FM transceivers are made in Japan and marketed through Henry Radio. This apparently results in a slightly lower dealer markup for other dealers, with the result that the Tempo gear is not urged on customers as much as higher profit items, to the detriment of this fine equipment. The Tempo amplifiers are made in California using U.S. components by TPL Company and are marketed for hams through Henry Radio. This also holds for the recently announced 220 MHz AM/FM transceiver which should be coming off the assembly line in the latter part of April. The 146 MHz version of this unit probably will see the light of day along toward the fall or end of the year. If it looks as if it will break sooner you will find out about it first in 73. In the meanwhile there is the Comcraft 2m AM/FM rig, which is very nice and fun to use . . . if rather expensive.

RTTY ART

Regarding the article in the January issue, RTTY ART MADE EASY, in the contents you state "A new art form is born." At first I objected because RTTY "art" has been around for years. Then I had second thoughts regarding WA6PIR. I've copied him on amateur RTTY and, friend, your statement is entirely correct, a new art form *has* been born!! Don has taken it out of kindergarten and put it up with *real* art. I have some of Don's art that you didn't print and that also is really fantastic. Thanks for running the article.

"Bud" Resch WØFTD

W. M. Richarz WA4VAF
4124 Colebrook Road
Charlotte NC 28215

SSTV MONITOR THE EASY WAY

One afternoon about six months ago while tuning across the lower end of the 20 meter phone band, I came across some very odd sounding signals. They were musical like notes similar to Teletype, but it wasn't Teletype. I listened further and found it to be two stations transmitting slow scan television. One station commented he could see the cracks in the other fellow's teeth. That did it. I was hooked – I had to have one of those things. Well, right there was the catch. There wasn't a thing that was commercially built that I could just go out and buy. A few weeks later I did see an ad of Robot's in one of the ham magazines. The price came to about what I would expect to pay for a nice transceiver. No way to get that by the XYL.



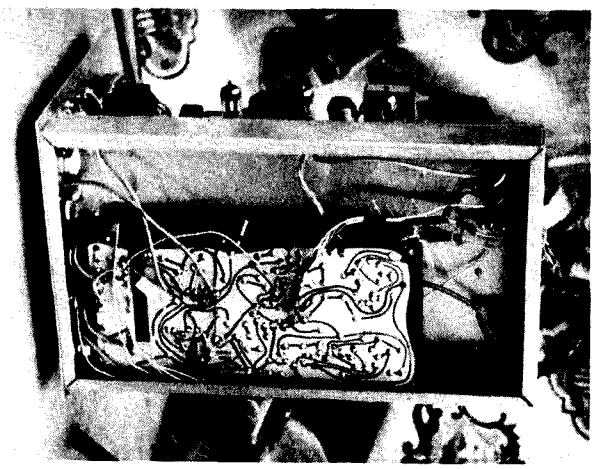
The completed monitor in store-bought cabinet. Outboard power supply on top. Panel was given a professional look by silk screening. Also note high-voltage wire enclosed in vinyl sheath for neatness.

In the meantime I had written to W4UMF[1] and sent along a self-addressed, stamped envelope, for a bibliography he had compiled. After going over the bibliography and locating most of the articles, and also discussing SSTV with the fellows on the SSTV net, I decided to build the Macdonald Monitor[2]. Along the way I noticed an ad in *73*. EKY Video Vision[3] had a kit of parts to build the monitor for a modest cost. One could also buy the two PC boards for a nominal fee and supply the parts himself. After looking over the parts list in the 1964 *QST* article and pricing them, I chose to order the complete kit. My junkbox was at

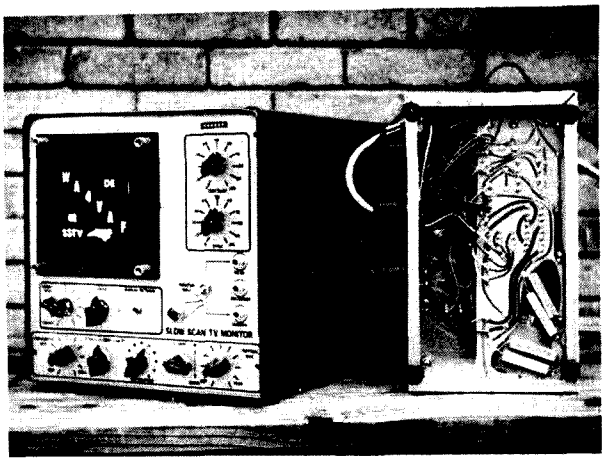
an all time low at this time, since I had made a move a couple of years before. New parts are high these days, but a fellow who has the time and patience plus a few good friends with well stocked junkboxes, can build this monitor for less than the cost of a lifetime subscription to *73*.

EKY was a little slow in getting the kit to me but that gave me some time to scrounge a 5ADP7 from a local surplus store, complete with mu metal shield for $5. I also ordered a cabinet and chassis from one of the popular mail order houses. I chose a cabinet that resembled EKY's in the ad. I wanted this project to have a good appearance since naturally I would have to be looking at it when it was in operation, and I dislike looking at a sleazy panel with controls and switches haphazardly protruding from it. I also wanted a professional lookng panel and wrote EKY for a drilling template, explaining what I wanted to do. EKY replied by asking me to mail my panel to them and they would silk screen it for me at no charge. This they did and in a few weeks I had a very good looking panel that only required drilling.

The kit arrived, and on inspection everything looked okay. There were a few parts that were substituted and these were noted in the boxes in which they were packed. Some of the small transformers would not exactly fit over the holes that were predrilled in the boards for them. It was no problem to drill additional holes to accommodate the new parts; after all a fellow with



Underside view of the monitor. Plenty of space for deflection board and power supply would fit if you really squeeze it together.



The completed monitor. Underside view of power supply shows EKY circuit board that makes for simple construction.

an Advanced ticket who plans to operate SSTV should be able to improvise some. Instructions do come with the kit and they are also supplied if you order the boards only. Don't expect the instructions to match the big time kit-makers; no "red wire soldered to lug B, etc." The boards are silk screened on the component side with the part numbers indicated. The boards make the job of assembling the monitor a real snap compared to what one would have to do with point-to-point wiring from the magazine article. Mounting of the shield, CRT and controls is left to the individual's preference. There are no instructions covering this since different chassis and cabinets may be used. There is mention of insulating the focus and brightness controls from the chassis or panel, since these controls have high voltage on them.

The picture on EKY's flyer shows the signal board mounted upright on the chassis next to the CRT. I chose to follow this layout as closely as possible since I had the same cabinet and chassis. The picture on the flyer does not show how the deflection board is mounted, but it is submounted under the chassis on standoffs. A large rectangular hole is cut in the top of the chassis to allow the tubes to protrude through.

About this time I decided to build the power supply outboard since it would be crowding things on the chassis, although it is possible to combine the two. Building the supply outboard is a must if the mu metal shield is not used. This works fine anyway

since you can also use the supply to power a flying spot scanner. I was looking ahead to this. I ordered the power supply PC board and components from EKY also as I could not locate too many of the parts. (They are not that hard to find if you are in no great hurry.) The PC board is a real life saver here also, and I would recommend obtaining it even if you do scrounge the other parts. Everything goes on the board easily and it makes the supply neat and compact. The supply itself is all solid state including a dc filament supply for all the tubes and a separate dc filament supply for the CRT.

I put the kit together over a period of several weeks, so all loose wires were labeled with masking tape as to where they should tie in or connect. No problems were encountered along the way. I used a nine pin socket and plug to connect the power supply to the monitor and a separate four pin socket and plug for the two high voltage leads. High voltage wire was used in these two leads and was run through a length of vinyl sheath for neatness.

Time for the smoke test. Apparently everything was wired correctly as nothing smoked or got hot. The instructions also include tuneup and operating procedure. Two TV horizontal width coils are tuned to 1200 Hertz and 2300 Hertz. The instructions call for an initial setting of the slugs and after tuning them with an audio signal generator they proved to be nearly correct. I suspect you could get away without tuning them with the signal generator as these two



The completed monitor with outboard power supply. Note the sub-mounted deflection board to the left and behind the panel. The cabinet which houses the monitor also has a neat carrying strap.

adjustments are not too critical. The trace on the CRT should appear in the lower right hand corner – mine was in the upper left. The instructions point out a possibility of this happening and the solution is to reverse the deflection plate leads. Having done this, the trace was where it should be. In getting ahead of the instructions I tried to center the trace on the face of the CRT. This was the wrong thing to do, as I found out after reading further along. An SSTV signal must be present to drive the sweeps and under no signal conditions the spot is kept off the face of the tube. This way you don't burn a hole in the phosphor of the tube when no signal is being received or have the tube covered with out-of-sync information during a weak signal period.

The only problem encountered was with the vertical sync adjustment. When a vertical sync pulse was heard the beam would not start a new raster. It took some fine adjusting but there was one best point where the pulse started the raster. Once this control is adjusted it need not be touched again. In fact, it is mounted on the deflection board and inside the cabinet, as is the horizontal sync control. The horizontal control setting is not at all critical.

I must admit I had quite a time adjusting all the controls on the front panel. A good tape of SSTV signals is a must and will make the job much easier. Trying to make the adjustments from signals off the air can be quite frustrating. A darkened room or shield around the CRT face makes for easier viewing. It took almost a whole day of playing with the different controls to become quite familiar with them. This is not to say it is hard to tune the monitor for SSTV, because it isn't. You do have to have a working knowledge of what each control will do and some experimenting and just getting the feel of the controls. Once the monitor is set up you need only touch the contrast and brightness controls, as you would a conventional TV set. Occasionally you may need to reset the sync control on the front panel to allow for variations in a transmitted signal.

So now you have a monitor and no flying spot scanner or camera to transmit. What can you do till then? A few sketches with

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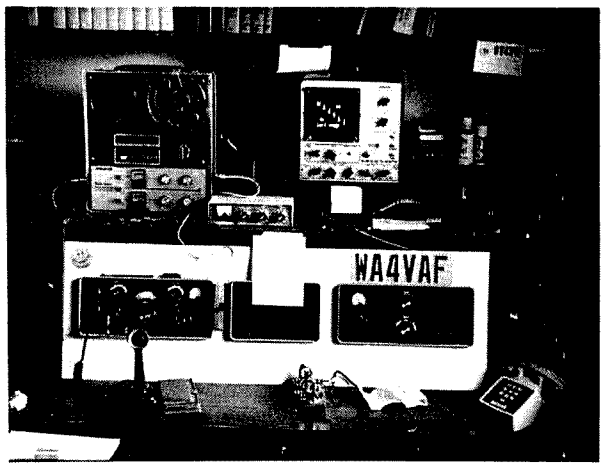
ERRATUM

On page 22 in the April 1972 issue of 73, a curious and inexplicable error was allowed to occur. Two lines of type were neatly lopped off the bottoms of the two columns on that page, apparently by the mechanical process of reproducing the photograph, thus rendering the text incomprehensible. To date, exactly one of you out there has noticed this egregious error. . .for his benefit we herewith print in full the two paragraphs affected:

In order to assure sufficient flow some small holes should be left in the lower chassis. Leave the holes open in the corners of the chassis as *manufactured, but close up the hole in the* octal socket and at the filament transformer with putty or plastic tape.

Parts placement is not critical. Keep components in the lower compartment away from the grid coil which is supported by the tube socket on one end and the grid tuning capacitor on the other. The grid *choke is made in the same manner as the* plate choke, but with only 30 turns.

There. That's better, isn't it? The missing lines are, of course, those in italics above.



Monitor in operating position. A hood was added to the monitor for easier viewing and with it full room lighting may be left on.

CQ de your call, test patterns and also good quality photos of the shack sent to an active slow scanner with a small roll of recording tape usually brings back all one needs to transmit SSTV from your tape recorder through the mike jack of your SSB transmitter.

The next project here will be an FSS. Here again there are many ways to go, but after looking over the bibliography I think I will try the one from *73* July 1967[4], or possibly EKY's FSS kit. Why not, since the monitor turned out so well.

The first step is definitely the monitor though. I have received many SSTV pictures from hams in the states and also some DX stations and with S9 signals the monitor really does an excellent job. At times when signals are down in the noise, a picture containing contrasting call letters can be seen and read when you cannot hear the station's call on SSB. There are probably quicker and easier ways to get on SSTV, and probably even better circuits with IC's, but for the fellow who wants to get a monitor going with a minimum of fuss and know-how, for the money, the EKY board and/or kit seems to be the ideal way to go.

. . .WA4VAF

References

[1] T. J. Cohen, 6631 Wakefield Drive, Apt. 402, Alexandria VA 22307.

[2] Macdonald, C. *A Compact Slow-Scan TV Monitor, QST*, March 1964.

[3] Box 15, Stockholm NJ 07460.

[4] Hutton, L.I., *A Slow-Scan Television Picture Generator*, 73 October 1967.

Prepared by
Carl Martens
Applications Engineering
Motorola Semiconductor Products Inc.

A 40W 6-METER FM/CW MOBILE TRANSMITTER

This report describes a three-transistor transmitter capable of providing 40W continuous power output at 50 MHz in operation from a 12.5V supply.

The transmitter described in this article is designed for CW or FM operation; it is not suitable for AM operation at a 40W carrier level since this would require peak power voltage capabilities exceeding the rating of the 2N5849 final stage transistor.

A signal source providing 20 mW at 50 MHz is required for the transmitter. Provisions for keying or frequency modulation are not described, but such features can easily be added to fulfill the requirements for a specific application.

A schematic of the transmitter is shown in Fig. 1, and the performance data appears in Table I.

The first step in designing this power amplifier is determining the required number of stages and the necessary gain per stage. A block diagram as shown in Fig. 2 is helpful in this estimate. The desired output power is 40W into 50Ω. According to the data sheet, the 2N5849 transistor can provide 40W from an input power of 6W. If a 1W allowance is made for circuit losses, the required drive for the final stage becomes 7W. The 2N5847 is rated at a power output of 7W for an input of 0.5W,

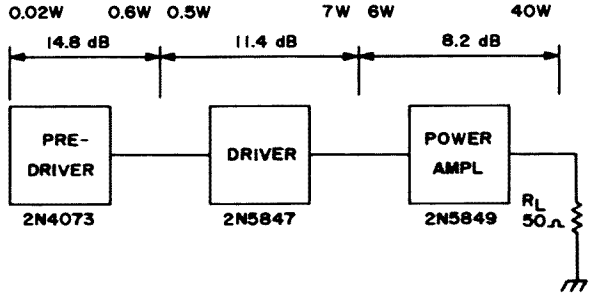


Fig. 2. Transmitter block diagram.

and the 2N4073 has sufficient gain to provide about 0.6W from 20 mW. This completes the block diagram and the basic specifications for the individual stages.

Circuit Description

The basic requirement of high power with good efficiency suggests a class C amplifier design, and the common-emitter

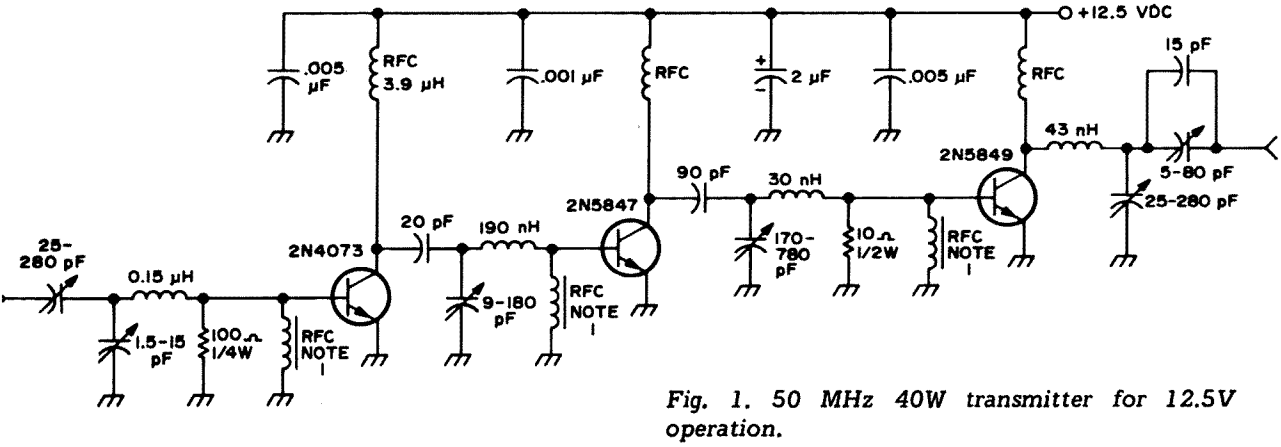


Fig. 1. 50 MHz 40W transmitter for 12.5V operation.

Table I. Transmitter Performance Data

Power Output	40W
Power Input	20 mW
Supply Voltage	12.5V dc
Total Current Drain	5.4A
Overall Efficiency	59.2%
Second Harmonic Output	25 dB down
Third Harmonic Output	45 dB down
Final Stage Current	4.7A
Driver Stage Current	0.65A
Predriver Stage Current	50 mA

configuration is selected for high power gain.

Final Stage Design. At the operating conditions applicable to the present design problem, the large-signal impedance data for the 2N5849 transistor have the values shown in Table II.

Table II. Parallel Equivalent Large-Signal Parameters — 2N5849

V_{CC} = 12.5V; f = 50 MHz; P_{out} = 40W		
R_{in}	0.8	Ohms
C_{in}	500	pF
Cout	625	pF
C_{out}		

The resistive portion of the collector load impedance, R_L, may be calculated (assuming a peak-to-peak collector-voltage swing of 2 V_{CC}) by using the expression:

$$R_L = \frac{V_{CC}^2}{2P_O}$$

where P_O = rf power output and V_{CC} = dc collector supply voltage.

For the 2N5849 the collector load is:

$$R_L = \frac{(12.5)^2}{2 \times 40} = 1.95\Omega$$

As the load impedance is small compared to the 50Ω termination impedance, the

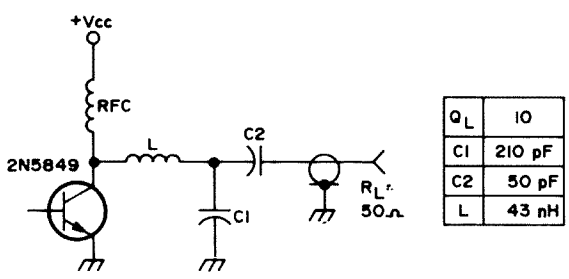


Fig. 3. Output network

network configuration shown in Fig. 3 is well suited for the final stage. The values of the network components may be found directly from the tables in Ref. 1. Several combinations are possible for the network components, depending on the value for Q_L, the loaded or operating Q. A loaded Q of 10 provides convenient component values, good harmonic attenuation and smooth tuning.

The driver/final interstage network must match the input impedance of the 2N5849 to the required collector load impedance of the 2N5847, which at the required drive power level of 7W is 11.2Ω in parallel with 160 pF. Reference 2 outlines a method for obtaining large-signal transistor impedance data.

Again a tee configuration is selected, and the circuit parameters are shown in Fig. 4. Proper biasing of the final stage is obtained by connecting an rf choke from base to ground. The selection of this choke is somewhat empirical, but as a rule its

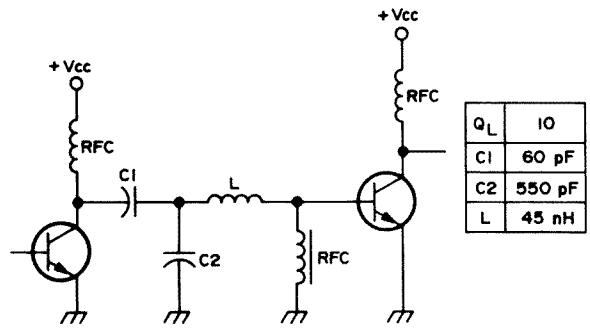


Fig. 4. Driver/final interstage component values.

inductance should be kept as low as possible, and it should be a low-Q type to avoid possible resonance with the base–emitter junction capacitance. Ferrite-bead chokes are well suited for this application.

It is also important that the resistance of the collector choke be as low as possible. In rf power stages, collector currents are often several amperes in magnitude: therefore, resistances as little as 0.1Ω can cause significant power loss.

Driver Stage Design. The tuned network must match the output impedance of the predriver stage to the input impedance of the 2N5847 driver stage. A tee network is

chosen, and the computed circuit parameters appear from Fig. 5. Biasing of the driver stage is accomplished in a similar fashion as for the final stage.

Predriver Stage Design. All that is required to complete the design of this stage is determining an input network providing an impedance match between the input impedance of the 2N4073 transistor and the 50 + j0Ω generator impedance.

Following the procedure outlined in Rf. 1, the network shown in Fig. 6 may be calculated. Component values are shown in the figure.

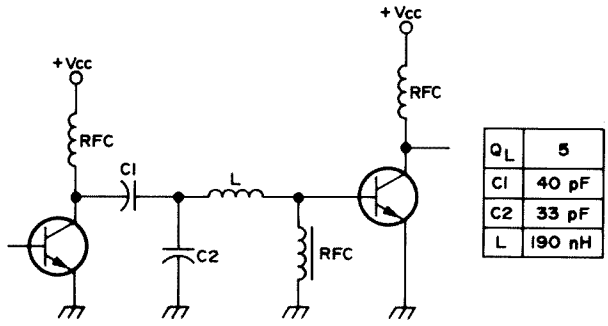


Fig. 5. Predriver/driver interstage component values.

Thermal Considerations

From the performance data listed in Table I, the power dissipated in each stage, P_D, may be calculated using the expression:

$$P_D = P_{in(RF)} + P_{in(DC)} - P_{out(RF)} \quad (2)$$

Solving Eq. (2) for each stage in the transmitter yields:

Predriver: 45 mW
Driver: 1.625W
Final: 24.75W

A heatsink for the output transistor may be evaluated from the expression:

$$\theta_{SA} = \frac{T_J - T_A}{P_D} \quad \theta_{JS} \quad (3)$$

where T_J = maximum junction temperature,

T_A = ambient temperature, and

θ_{JS} = junction-to-heatsink thermal resistance.

Furthermore:

$$\theta_{JS} = \theta_{JC} + \theta_{CS} \quad (4)$$

where θ_{JC} = junction-to-case thermal resistance

θ_{CS} = case-to-heatsink thermal resistance.

For the 2N5849 transistor, the following thermal data apply:

$T_J = 200°C$

$\theta_{JC} = 1.75°C/W$

$\theta_{CS} = 0.25°C/W$ (Using a thermal compound and mounting nut torqued at 8 in.-lb)

Substituting the 2N5849 data in Eq. (3) for a worst-case ambient temperature of 60°C yields:

$$\theta_{SA} = \frac{200\text{-}60}{24.75} - (1.75 + 0.25) = 3.65°C/W$$

If operation at an ambient temperature higher than +60°C is desired, the device dissipation-derating information on the transistor data sheet and Eq. (3) and (4) may be used to complete the heatsink design for all three stages.

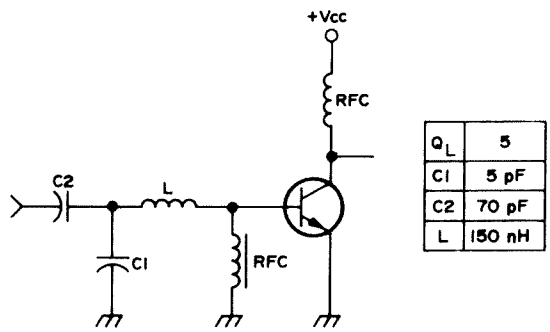
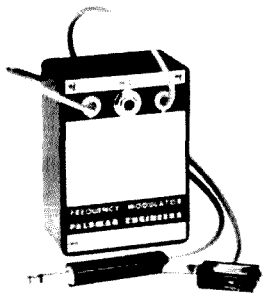


Fig. 6. Input network.

Construction

In the construction of the transmitter, the usual precautions normally taken in rf work must be observed. The selection of ground points is particularly important. The chassis current path between the base-choke grounding points and the emitter grounding points must be kept very short to reduce inductance. Variable capacitors are used in the tuned circuits to facilitate adjustment of network loading and tuning. A fixed capacitor is used in parallel with the output-stage series capacitor to provide protection against complete decoupling of the load.

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All base chokes in this construction are low-Q types from the VK-200 series manufactured by the Ferroxcube Corporation of America. The 100Ω resistor in parallel with the predriver base choke and the 10Ω resistor in parallel with the final-stage base choke were incorporated to insure circuit stability for a wide range of drive levels.

It appears from the complete schematic of Fig. 1 that the fixed capacitors in the two interstage coupling networks are different from the calculated values. This is due to the fact that the type of capacitors used, phenolic-encapsulated silver micas, were found to differ from their nominal values at 50 MHz. The correct values of 40 pF and 60 pF were determined by measuring a number of capacitors.

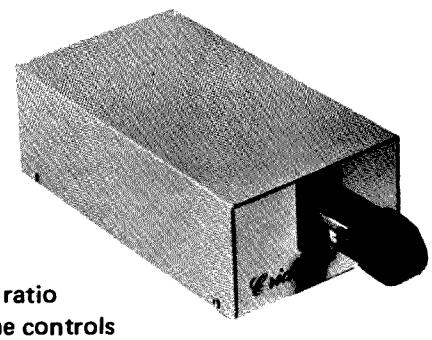
References

1. Davis, F., "Matching Network Designs With Computer Solutions." Application Note AN-267, Motorola Semiconductor Products, Inc.
2. Hejhall, R. C., "Systemizing RF Power Amplifier Design." Application Note AN-282, Motorola Semiconductor Products, Inc.

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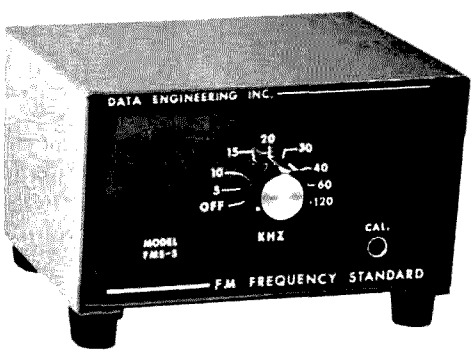
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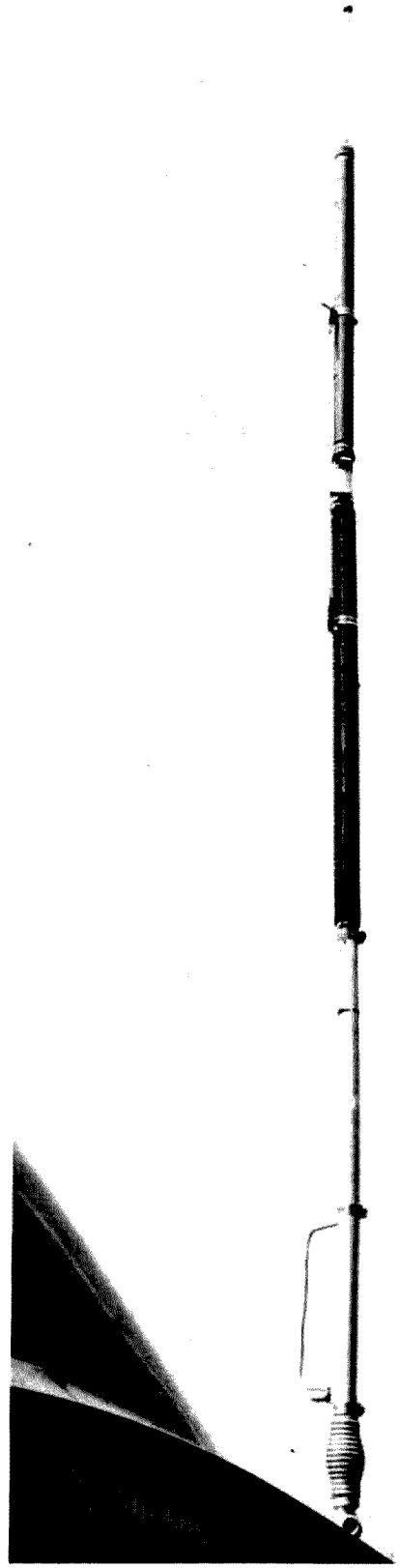
QUICK BAND-CHANGE MOBILE ANTENNA

All antenna systems represent a compromise. One of the greatest is that of squeezing a 3 MHz quarter-wave onto the back of an automobile.

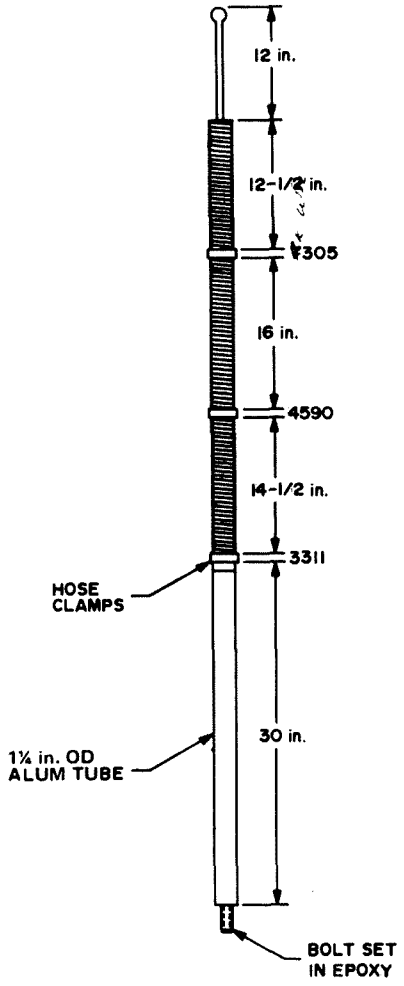
A look at the price tag affixed to commercial antennas should provide you (as it did me) with a strong incentive for "brewing your own."

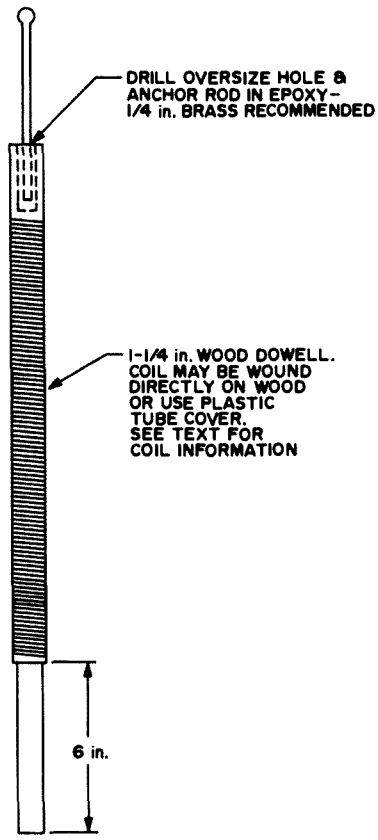
And price, while a major factor, may not be the only consideration. For example, I needed a positive, quick-change antenna, to hit Air Force MARS frequencies. Namely, 7305, 4590, and 3311 kHz.

The antenna shown in the picture is the result of four brewing ventures. Prototype



Antenna installed on 67 Chev. Used with Motorola SB3 Rig.
The coil is wound in two sections. Would be equally successful if wound in one section. Past models have been made in one section. Shorting bars in place for 40 meters. Two sections used here because of available coil forms.





l was temporary, being wound on a bamboo fishing pole. Taps were brought out, with many trials and more errors; however, this temporary antenna worked so well it literally stayed on the car until the base "rotted" off. Had I coated the fishing pole with epoxy, I would probably still be using it. This antenna was wound with plastic-coated 20-gage stranded wire.

At the demise of the bamboo pole, I decided to be smart and refer to the handbook. I read and studied, and ended up with a very nice looking "outer-space" antenna, with a big-wire coil in the center. The transmitter loaded. The receiver worked swell. Only one small problem: Nobody could hear me.

Maybe it wasn't quite that bad. But the signal was down many dB. The center-loaded antenna did not deliver the signal that the top-loaded fishing pole punched out.

So I set to work to rebuild a better looking and more rugged "fishing pole."

The antenna now in use has two coils, each 2 ft long. The only reason for using two coils is that by loosening a clamp, the top section of the antenna may be easily removed. Also, it requires a long coil to hit 3311 kHz, and the necessary forms may be available in shorter length. Whether the coils are wound in one or two sections makes no difference in the operation or tuning of the antenna.

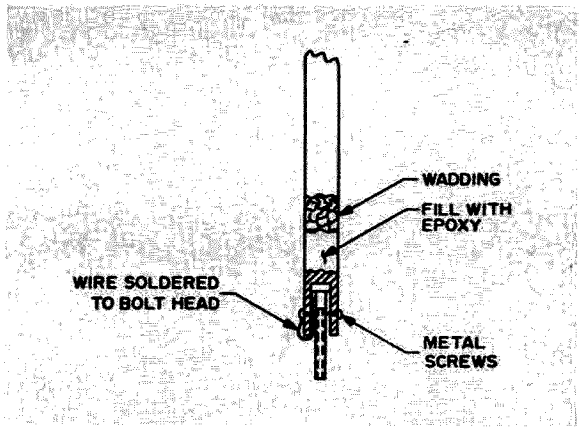
Also, a shorter coil length may be used if only higher frequencies are to be covered. For 40–10m, a coil about 14 in. long is required. (Increase base length to 60 in.) For 75–10m, approximately 3 ft is needed.

Actual construction and tuning of the antenna is easy. No special tools or equipment is necessary.

The base section of the antenna is a piece of aluminum tubing 30 in. long. The bolt, with threads to match a heavy duty spring mount, is securely anchored in the base with epoxy. Three sheet-metal screws,



Fig. 1.



with the tips filed so that each barely touches the bolt, are useful in two ways. Helping to center the bolt, and keeping the epoxy plug from turning in the tubing after hardening, braid is soldered to the bolt and brought out through a small hole in the tubing. The braid is later clamped to the antenna with a hose clamp which reinforces the base and holds the 47 dial light indicator socket. Wadding keeps the epoxy where needed. Be careful. The bolt must be straight when the epoxy is poured.

One satisfactory way I have found for winding the coil is directly over a wood dowel. If you have access to a lathe the dowel should be grooved to space the wire about one diameter. Or you may wind a string or another wire between turns, which may be later removed. (The coil should never be closewound, unless plastic insulated wire is used. The plastic provides the spacing.)

At least 6 in. of the wood dowel should be sanded, whittled, or turned down to fit snugly into the aluminum tubing base. Slot the top of the tube 1 in. A hose clamp will hold the coil in place and provide a terminal for the wire.

The tip section of the antenna may be any conductor. However, since this tip will receive some hard bumps, I recommend a section of ¼ in. brass rod. Solder a wire to the rod. A 5/8 in. hole is drilled in the end of the wood dowel coil form. Wire and rod are anchored in the dowel with epoxy.

After the coil is wound and tip fitted, cover it with a good coat of resin to securely fasten the wire in place.

Another method of winding the coil is to use a piece of 1¼ in. plastic pipe or other coil form and slip this over the wood dowel, which may be an old broomhandle with a layer of tape applied. Fasten the ends of the plastic to the dowel with screws. Dowel should be long enough to extend 6 in. down into base. Tip is attached as previously outlined.

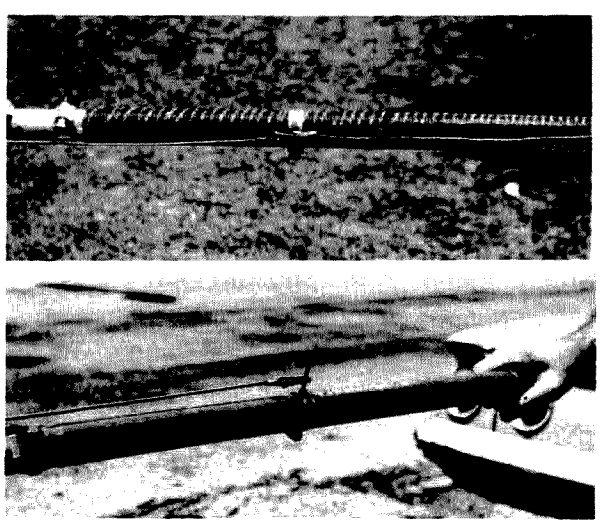
Or the plastic tube may be "splinted" to the base and temporarily "outside taped." Then the coil form and 6 in. of the base are filled with epoxy. The tip is placed in position and the whole thing hardens. This method is especially useful for the short coils, 40m and up.

A 36 in. plastic tubing form may be bought at a sporting goods store for about a dime. Just ask for the plastic covers designed to keep golf club handles from being scratched in the bag.

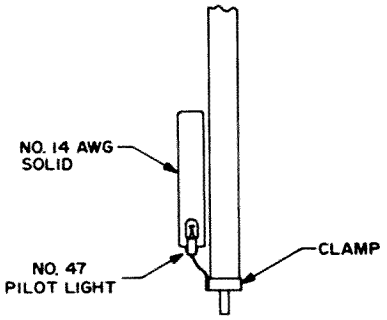
I have used coils constructed all of these ways. Using the wood is easier and works equally well. In any case the wire must be cemented in place.

After the coil is dry and both ends of the coil attached electrically to the base and tip, you are ready to start the tuneup.

For each frequency to be covered you will need a slider. Each slider is made of one hose clamp and one 6-32 brass bolt and nut. File the bolt head slightly flat.



Closeup of slider tap and shorting bar connections.



Indicator.

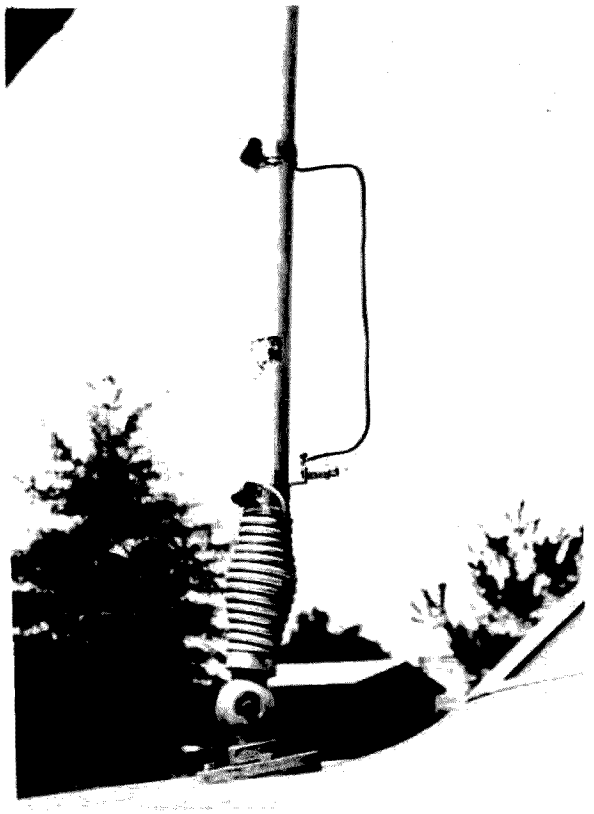
Drill a hole through the hose clamp. Insert the bolt from inside the clamp, securing with the nut. The bolt head will make contact with the wire coil.

By using the approximate measurements shown, estimate about where the tap should be for the frequency you wish to hit. With a coarse file cut through the resin and any insulation on the wire for 4 in. Your coil at this point will resemble a 100W slider resistor.

Now install the antenna on the car and place the receiver in operation. Work on the highest frequency first. For example I tuned 7305 kHz first. Then 4590, and finally 3311 kHz.

Attach a wire to the top of the base section long enough to reach the top contact area of the coil. Run the wire back and forth over the contact area. You will hear the receiver background noise peak sharply. If it fails to peak, but gets louder in one direction you may have to file some more. At the point where the receiver peaks, the antenna will take a load, but will probably require a bit closer adjustment.

Next install your output indicator, a 47 light bulb. I leave this indicator in place at all times. It provides positive "on the air" indication, not to mention what happens at night when a car pulls up behind and sees the sideband modulation waving in the air. The indicator is a loop of wire about 16 in. long, with one side of the loop taped to the antenna at the base and the 47 bulb in series with the outside of the loop. If it is desired to leave it permanently in the circuit it may be tapped across about 8 in. of the base using the antenna itself as one side of the bulb loop.



The 47 dial light output indicator. This light bulb shows at all times positive indication of on-the-air and is all you need to tune and load the transmitter. The loop in this instance is completed by the antenna itself. Can also be used as a complete loop taped to the antenna.

Using the bulb as an indicator, finish tuning until the desired loading is obtained.

Repeat the tuning procedure for each lower frequency desired. Then permanent shorting bars should be made. Brass welding rod and alligator clips are ideal.

Changing frequency is simply a matter of removing, or using the proper shorting bars. If several frequencies close together are required, several taps can be brought out every turn or every two turns, and a braid with attached alligator clip may be used to short out the unused portion.

This antenna has delivered plus performance. And when it comes to changing bands, it can be done in less than 30 seconds without hurrying, and this includes getting out of the car and back in. Every time the antenna will be in perfect resonance.

I scrounged everything. But if you have to lay out the cash, $5 should suffice.

Interested?

. . .W4LLR - AF4LLR■

Bill Hoisington K1CLL
Far Over Farm
Peterborough NH 03458

A Hi-Fi IC For Amateur Modulators And Receiver Audio

This is an introduction to the Amperex TAA300 Integrated Circuit af amplifier, a winner! When I say another winner I mean of course that it is Amperex who has the winner, because this little gem comes ready made for you in one of those little ten pin cans less than 3/8 in. OD. I should say nearly all as there is a collection of *external* accessories, some of which are much bigger than the IC itself. You can obtain these items in a much reduced size to match the IC, for a price, but we are concerned here with the Amperex TAA-300 IC af amplifier using readily available and amateur-priced parts.

Features of this device include high sensitivity, low cross-over distortion, low harmonic distortion, and high efficiency. And, I might add, a great sound!

See Fig. 1, internal diagram, and Fig. 2, the total circuit. This is one of those jobs using 11 transistors and four diodes when you might expect at the most, five active devices. However, any questions in my

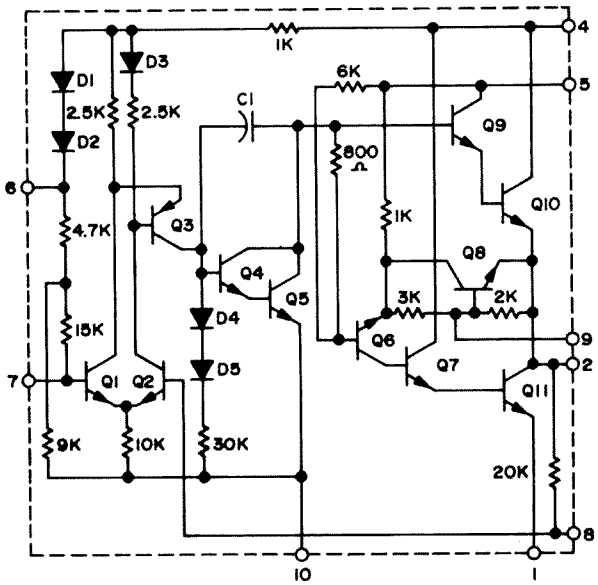


Fig. 1. Internal schematic of the TAA-300 Amperex audio amplifier IC.

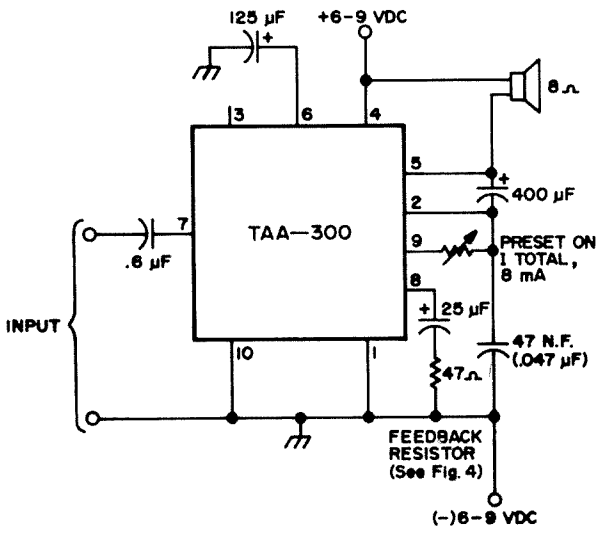


Fig. 2. External schematic of a complete audio amplifier using the TAA-300 IC.

mind were immediately dispelled as I listened to it with my favorite mike and hi-fi padded earphones. It actually sounded better and clearer than any af amplifier I have heard in a long time, with plenty of lows and highs evident, and lots of power and gain too. Every one of those eleven transistors inside that tiny package are certainly doing their stuff in the proper fashion.

Special measures have been used to prevent cross-over distortion with a supply voltage ranging from 4.5 to 10V, dc. There is a "bias set" resistor running between pins 2 and 9 which serves to set the current to a rated 8 mA total on no signal (see details in the external schematics, Fig. 2). When this resistor is varied and the total current drops much below 8 mils you can hear the cross-over distortion begin on low volume signals such as whispering in the mike. When set at 8 mils, even the lowest volume signals are clear and free from distortion. The large amount of negative feedback also helps reduce distortion to a minimum. At a power output of 1W, which is the TAA300's rating with heatsink, into

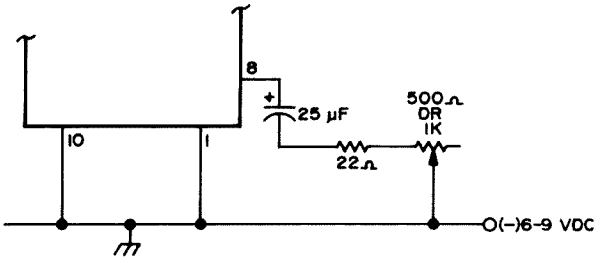
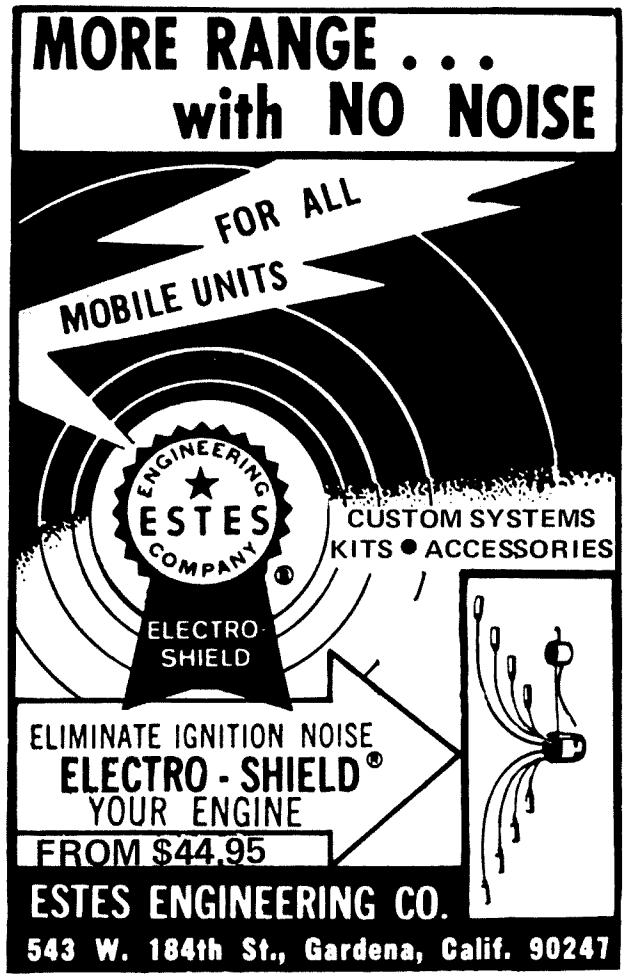


Fig. 3. Variable feedback control.

an 8Ω load, it still sounds great. The bandwidth at the 3 dB points goes from 30 Hz to 25 kHz, so, even though this sounds fine on a receiver, be sure and *reduce* that bandwidth when using it as a modulator.

At a power output of 1W the total current on the battery goes up to 180 mils, just like one of those regular old tube modulators you used to use. Of course the voltage is only ten so we're not talking about 180W, just 1.8W, which is still fine for portable all-solid-state rigs. The rated efficiency is 60%, which in my opinion is excellent for a good quality audio amplifier.

The input impedance is close to 10K and with my favorite mike, the Astatic



150, full output is obtained with the mike over a foot away. The reasons why the 150 is my favorite are: the price at $3.82, and the output of minus 44 dB which is the highest I know of. With no signal into the TAA-300 the noise can be heard in the earphones, but it is unlikely you would ever use that much gain. For all ordinary usage the amplifier is perfectly quiet.

The Variable Feedback Control

This feature certainly deserves a section of its own. Figure 3 shows the details. There is a 20K resistor carrying negative feedback from the midpoint of the output transistors Q20 and Q11, back to the base of Q2. This feedback line is bypassed to ground through a 25 mF capacitor. However, there is a resistor in series with this capacitor which in the external circuit diagram is specified as 47Ω. The amplifier works fine with that value, but wait until you try it with a variable 500Ω pot in its place! With the resistor value at zero, there is *no* feedback and the gain is terrific. With

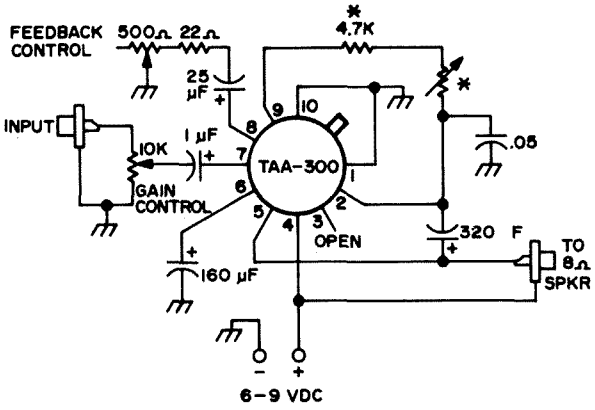


Fig. 4. Breadboard test setup for determining best values. Slightly different values are used here from Fig. 2. Read the application notes carefully for a list of the precautions to be observed while experimenting with this IC. Pin ten is also the case and can thus be grounded with a heat sink. A gain control is now always needed and may be replaced by a feedback control in some applications.

the pot wide open there is a lot of negative feedback and the gain is way down, but so is the distortion. Using the system as a gain control you are operating at all times with the least distortion and noise, and the feedback is at a maximum, which is good.

There may be a reason for not using this type of gain control, but since it sounds great I'm going to keep it in, particularly in modulator use.

Be *sure* and read the application notes if you are going to build. To prevent high-frequency instability, the following precautions must be taken: Keep the lead inductance from the positive supply voltage to pin 4 to a minimum. To counteract the high internal resistance of batteries, especially toward end of life, a 200 mF capacitor should be connected between 4 and ground. A capacitor of at least .05 should be connected between pin 2 and ground to prevent instability of the lower Darlington output transistor.

Avoid coupling between output and input leads, especially those carrying signals from a high-impedance source. This coupling can be reduced by using short leads, shielded input cable, or by limiting the upper frequency to 15 kHz by means of a 560 pF capacitor between pin 7 and ground.

The input lead and components will pick up lots of hum as a result of that excellent low frequency response if you do not take care with shielding. If you don't want all those lows, use a much smaller input capacity, especially for voice communication.

Layout

The layout I used for test purposes is shown in Fig. 4, although I imagine this can be packaged much smaller. The bulky items are the electrolytics, but once again Lafayette can help you reduce this size somewhat. I'll give just one example to illustrate. The 30 mF at 15V is only 5/16 by 7/8 in. long and costs only 23¢, if you buy 5 of them. Be sure and observe the polarity!

I used a 10K pot at the input, but with that fancy variable feedback bit you may not need it.

Be sure and follow the application notes, particularly the one about the lower Darlington output transistor. An input and output jack, a red and black battery lead, and you're on the air.

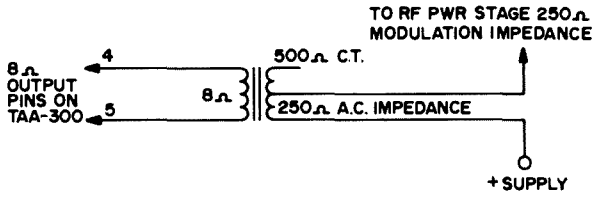


Fig. 5. Matching the output of the TAA-300 as a low power modulator using a small output transformer connected backwards.

From the way this little diamond sounds you'll be meeting it again and again in modulators and receivers. I suspect it will be very useful along with a "turned-around" output transformer, with the 8Ω side connected to the TAA-300 output and the other side, whose impedance should match the modulating impedance of your rf output power stage, in the 50 to 500Ω range. It should be connected with the secondary carrying the modulated dc to the rf stage, as shown in Fig. 5.

For receiver work just use an 8Ω speaker, period.

. . . K1CLL

Why won't Don Wallace listen to anyone else?

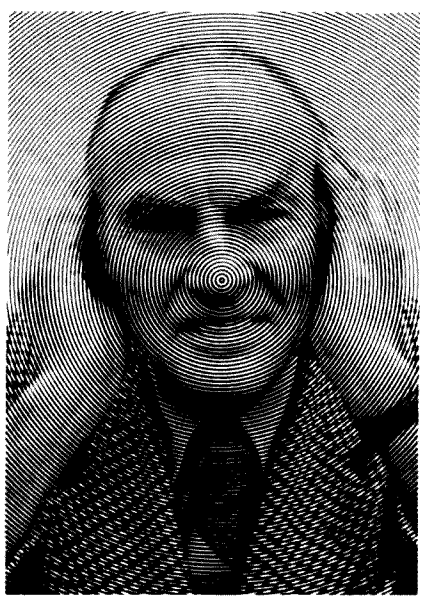
W6AM doesn't have to, since he began using our professional quality VHF-FM 2 meter transceiver with exclusive *Astropoint*. The precise and powerful Astropoint system actually blocks out all interference. So when one of the nation's number one hams is having a 2-way conversation he won't have unwanted interference.

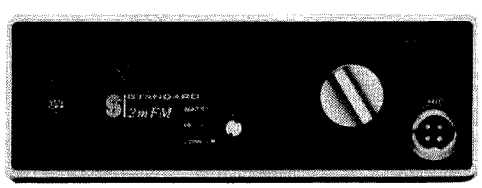
Astropoint is featured on all standard transceivers including the rugged, 12 channel SR-C826M.

It's not only a compact mobile but even fully portable with the addition of a battery pack.

And there's a lot more that appeals to Don about the SR-C826M than just Astropoint. All silicon semiconductors with solid state circuitry. Ten watts of R.F. output power combined with low power consumption. MOSFET R.F. Amplifiers and mixers. And the list of features goes on.

Which is why Don Wallace hasn't been listening to anyone else lately. Not that he's choosy about who he listens to. Just whose equipment he listens on.





For complete specifications and the name of your nearest dealer, write:

STANDARD COMMUNICATIONS CORP.
639 North Marine Ave.,
Wilmington, Calif. 90744
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73 TESTS and USES

The Larsen 5/8 Wave Antenna

After a few months of FM'ing, talking with FM'ers, and seeing two meter mobiles by the gross, the eye gets used to seeing a disproportionate number of the Larsen antennas on cars. They stand out immediately to the eye of the FM amateur for the simple reason that they are probably the most inconspicuous two meter antenna there is.

Larsen came into the ham market via the two-way commercial field, as did repeater two meter operation. Naturally these old time two-way men brought along the antennas that they had found to work the best and give the least trouble . . . Larsen.

That little antenna coil on the bottom of the antenna will handle 100 watts, which today is about the practical limit for FM operation. The coil is needed to tune the antenna since it is not resonant at the 5/8 wavelength mode and a good deal of high efficiency inductance is needed to get the swr down to where the transistor rigs won't balk. The Larsen irons out the problem to an insignificant 1.2:1 swr or better.

Larsen goes that extra mile in efficiency by silver plating their whip. We all know that silver is a better conductor of radio waves than copper or chrome (remember those silver plated coils in the better rigs?), so silver is an obvious plus for a mobile whip. And remember that the silver stays a good conductor even when it is oxidized.

The 5/8-wave length is excellent for two meters since it is long enough to provide a lower angle of radiation (more on the horizon) and thus an effective doubling of both transmitted and received power (+3dB) without being so long that it is a hazard or looks too much like a Charlie Brown whip.

Not wanting to make any holes in the Rover 2000TC, the Larsen NLA-150 antenna with NLA-TMB (trunk mount bracket) was used, plus a coax feedline and hardware mounting kit NLA-1K (installation kit). The price of the works came to $24.50 + 3.50 + 4.50 = $32.50. That's a pretty good deal for a complete trunk-mount antenna, with feedline and connector, all of commercial quality and built to last longer than the car.

For details on all of the Larsen antennas and various types of mounts you can get specifications from *Larsen Electronics, 11611 N.E. 50th Avenue, Vancouver WA 98665.* You might mention 73 when you write to them and address your letter to *Jim Larsen W7DZL.*

. . .Staff

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HOW TO GET THE STUFF INTO THE HOUSE

Unless your QTH operates on the kind of budget that permits sable coat Christmas presents for the XYL, in-ground swimming pools for the kids, your own ski chalet at Aspen and casual weekend jetting to Acapulco or Majorca, chances are you are up against a problem that has faced nearly every ham since Marconi: *How do you get the stuff into the house unseen . . . or, alternatively, how do you avoid telling her how much it cost?*

Over a period of some years of supporting several hobbies and during which acquisitions of new and used cameras, lenses, fly rods, table saws, shotguns, sports cars, etc., to say nothing of radio gear, had to be explained, rationalized, lobbied or even concealed, this practitioner has assembled a variety of ploys, some from personal experience and others from fellow-hobbyists, whose contributions I acknowledge with thanks and whose identities I had best keep to myself.

In the hope that some fellow-sufferer may find herein the solution to his particular problem, I have decided to compile and publish the best of these stratagems in what might be called, *"Hamsmanship, or How to Build Your Amateur Radio Station Without Actually Shedding Blood."*

Old masters at the game – AM types and single-letter prefix gaffers – may find some of these tactics old hat. But they will realize that a whole new generation of amateurs has come along and, further, the problem of getting the stuff into the house without touching off domestic warfare has escalated astronomically in these days of nearly 100% store-bought stations. Even the newest Novice, judging from the magazine photos, starts his career with an array of commercial gear that looks like the control panel of an Apollo moonship.

These new hams need our help. Let us share with them our secrets and our methods. The future – possibly even the survival – of amateur radio may well be involved.

One word of caution before we begin the lesson: Do not, repeat, *do not* leave this copy of 73 lying about the house for *her* to read. Commit these pages to memory and then rip them out and either burn them or put them in an envelope and mail to Box 88, Moscow. That way they'll never be heard from again.

Now, then:

1. This one calls for the breezy, off-hand treatment. You bring in the new scope, linear, keyer or whatever it is and before she can start with, "How much did *that* cost?", you cry happily, "Boy, you couldn't beat this for $15" (or whatever figure the traffic will bear). Remember, you didn't *say* you paid only $15 for it – just that you couldn't beat it for $15 – and that's the gospel truth.

2. The David Harum or old-mule-trader ploy. You come gaily into the house with your latest treasure, a smug grin on your face, and emit something like, "Wow! Look what I traded old Haywire Magee out of for my old rotator." Never mind mentioning that you also forked over $250 in addition to that old rotator to make the "trade."

3. A variation of No. 2: Your line is, 'Can you imagine the dope letting this go for only $35?" You sure can't, OM. His rock-bottom price was $150 and that's what you coughed up. But you didn't *say* you paid $35.

4. Another variation: You take the old rig to your friendly local ham dealer who sells used gear on consignment for a commission. A few weeks later you report happily, "Some guy bought my old rig and I got enough for it to get this new one." Yeah, enough maybe for the down payment – but who needs to know you still owe the friendly local etc. $398.80?

5. Become a home-brewer. Spend long hours in the basement workshop. Cut lots of scrap metal loudly. Drill lots of holes ditto. Bang chassis around. Let the smell of soldering and scorched insulation permeate the house. Study schematics at the dinner table. On the air, talk loudly about the linear you're building. After two or three weeks of this, come proudly upstairs with the new rig, or whatever. Stripped of nameplate, of course, or even without front panel. Some time later you can "acquire" a cabinet or front panel for it and,."Look, Honey, this old Collins (or Heath or Swan or . . .) panel I picked up just fits the rig. Looks real commercial, doesn't it?"

6. You need a garage or workshop where you can cache the parts of a beam for this one. Then you make a big show of going into the shop with an armload of old aluminum tubing, busted TV antennas, etc. Emerge some days later, after the usual drilling and sawing noises, with the elements of your new tri-band beauty and, "See what I lashed up. Amazing that you can do with a bunch of old aluminum." It sure is.

7. Your XYL has been bugging you about getting a new color TV. So you agree to buy one if you can have the old one for parts. Show her those great articles about how you can build a five-band KW transceiver with the parts scrounged from old TV's. You'll be surprised, and you hope she will be, too, at the nifty new rig (frequency counter, oscilloscope or whatever it is you dream of) you were able to build with those old TV parts (plus a few odds and ends from Heathkit, maybe.)

Many other suggestions for inclusion in this article were considered and discarded for such reasons as requiring outright lying, being too impractical or far-fetched, or too susceptible of detection. Others simply were variations of one or more of the above, such as disassembling a Whizzbanger 2000 at a friend's shack and then bringing it home piece-by-piece in pocket-sized components; or installing a new KWM2 in your old Viking I cabinet.

None of those so far mentioned, however, can top the one reported by a ham who of necessity shall remain unidentified here. At the time the first color TV was acquired for the family, he convinced the XYL that only a 60-foot tower and super-duper king-size antenna would bring in the color picture in their location. To this day she thinks that three-element trapped Lightningbird tri-bander is what makes Doris Day look so pretty.

The best we save for last!

Write a piece for 73 Magazine, and with the fantastic price the editor pays you for it, you buy the KW.

. . .W2OOJ

Ed Webb W4FQM/1
Technical Editor

ANTI-CW AUTOSTART

An Anti-CW Autostart System for the Phase Locked Loop Terminal Circuit

A phase locked loop terminal unit has been in use in daily unattended operation on the 80 and 20 meter RTTY autostart nets for over six months with good success. The original development and operational features of the PLL TU were described in the January 1972 issue of *Ham Radio*. The detector card remains unchanged and its circuitry is shown only for the sake of continuity and clarity.

During the six months of testing it became apparent that the automatic signal acquisition and tracking (as well as automatic shift selection) capability of the PLL was not

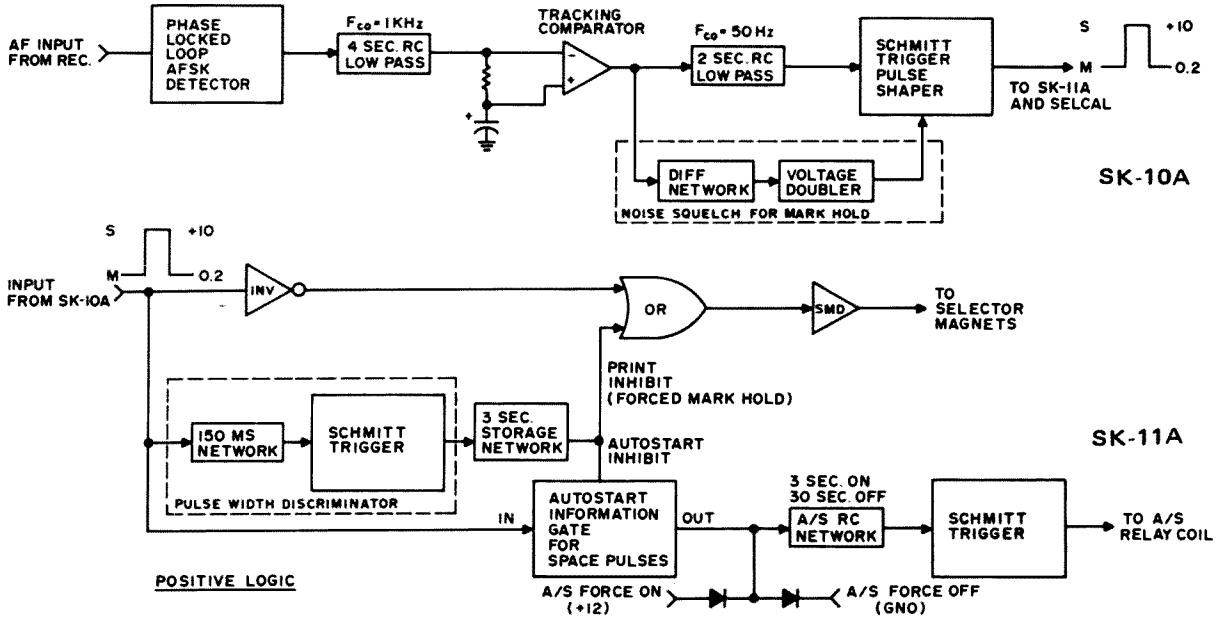
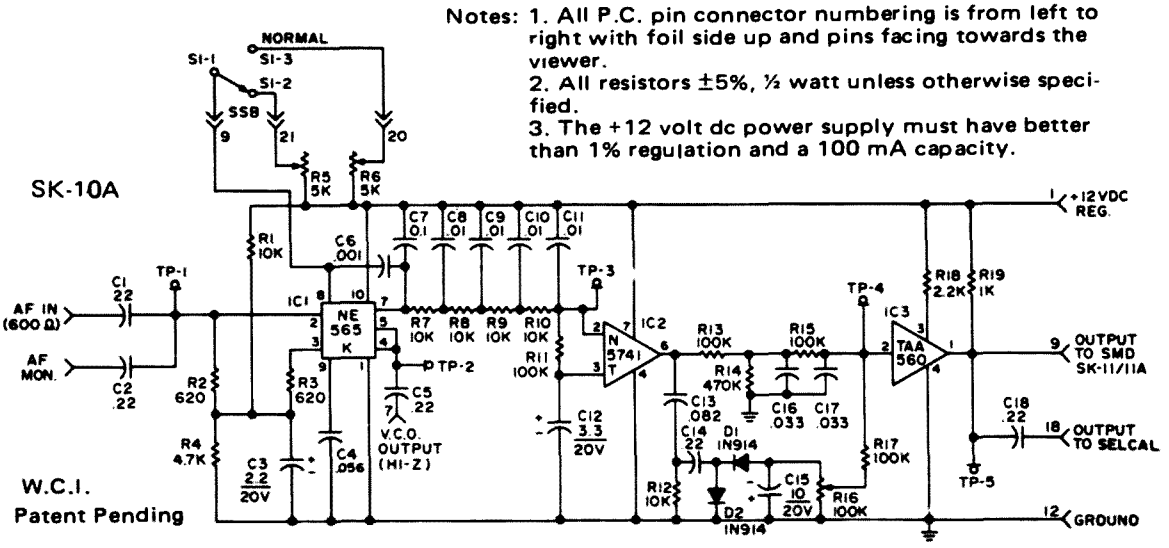


Fig. 1. Block diagram of TU.



(A) SSB mode input frequency range: 800–2200 Hz; VCO frequency set to 1500 Hz by R5.
(B) Normal mode input frequency range: 1800–3200 Hz; VCO frequency set to 2500 Hz by R6.
(C) Noise squelch adjustment R16 set for zero output at TP-5 with random noise input.

Fig. 2. Phase locked loop detector.

always an asset. In one case – that in which a CW signal came into the capture range of the loop – it proved to be a detriment. In this case the autostart would think that it was receiving valid RTTY information and cause the teleprinter motor to turn on, the result being a few feet of paper with nothing but garbage on it.

PLL AFSK Detector Characteristics

The PLL detector was designed to operate with low input tones from SSB transceivers or the normal range RTTY tone frequencies at the flip of a switch. The PLL detector would respond only to an AFSK signal that shifted higher in frequency during the space pulse. The PLL VCO normal resting frequency is set at the mid-range point of the lock frequency or capture range. If a CW signal appeared anywhere in the frequency range between the VCO resting frequency and the upper capture limit frequency the TU would lock on it as it thought it was a valid AFSK signal and it would activate the autostart. This condition will only occur when there is no valid RTTY signal present or if the CW signal is more than 8 dB stronger than the RTTY signal. The PLL has a capture effect much like that of an FM receiver.

Autostart and Selector Magnet Drive

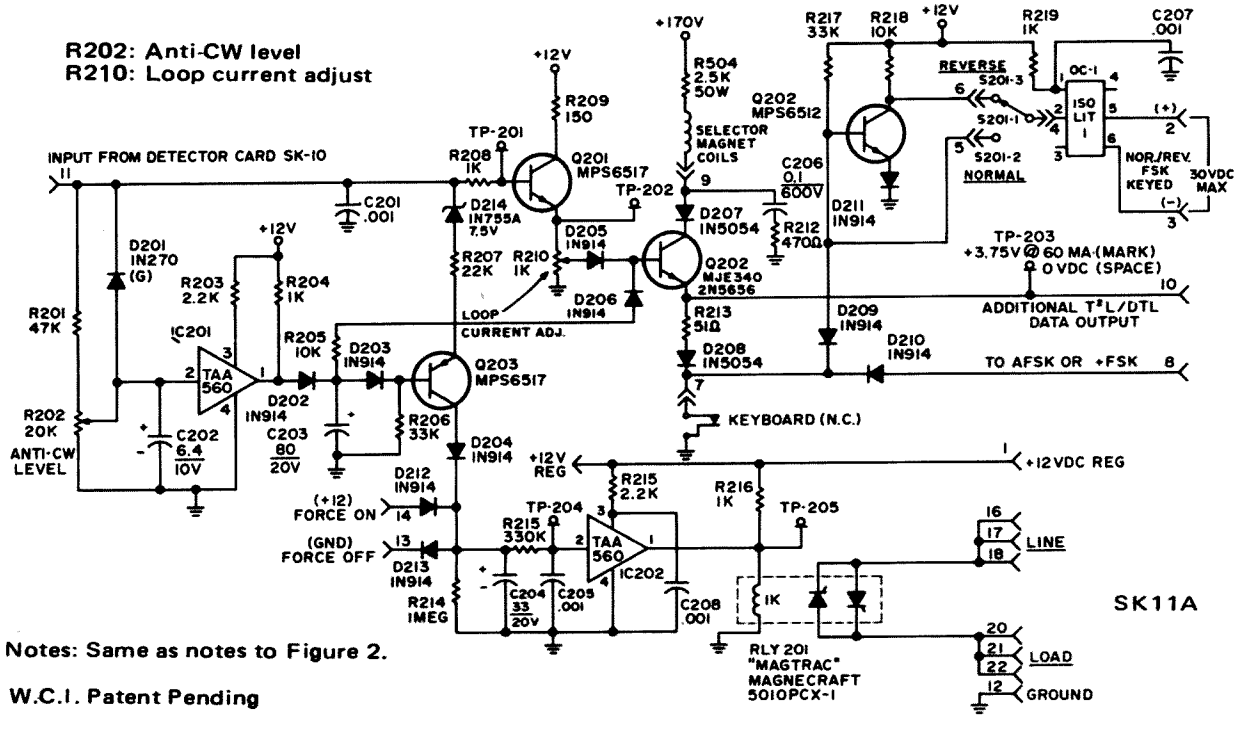
The original autostart was activated by space pulses charging an RC time constant to a predetermined trigger level. This trigger level caused a Schmitt Trigger to fire and activate the solid state motor control relay. The mark and space pulses drove an inverter that in turn drove a constant current type of selector magnet driver. The SMD (Selector Magnet Detector) gave extremely fast rise and fall times. The selector magnet keying pulses had very flat tops and little overshoot.

Anti-CW Autostart

The RTTY character having the longest space condition is the "BLANK" key. This character has all of its 5 level 22 ms information bytes in the space condition. These, plus the start pulse, have a total space condition of 132 ms at 60 wpm (45 bauds). Therefore we can add a little safety margin and say that any AFSK signal that causes the PLL detector to go to the space condition for more than 150 ms is not RTTY. Most CW signals under 15 wpm have "Dahs" longer than 150 ms and thus would activate a pulse width discriminator. The pulse width discriminator would be set for 150 ms and be fed by space pulses. In this case the output from the PLL detector is 0 for mark and +10V dc for space. These space pulses

are fed to both the selector magnet driver inverter stage and to a voltage divider R201 and R202. The output arm of R202 is connected to C202 that is in parallel with the input to Schmitt Trigger IC201. R202 and C202 form a simple RC charging circuit that is charged by the positive 10V space pulses from the PLL detector. The time or pulse width that it takes a space pulse to charge C202 up to the Schmitt Trigger's input firing point of about +1.5V can be set by adjusting R202. The positive space pulse is also applied to D201 and reverse biases it. However when the input from the PLL detector goes to the mark condition of almost 0V dc, the positive charge on C202 is discharged through D201. This way each time a mark signal or no signal is received (there is no output from the PLL on noise because of the noise squelch), the RC timing circuit is reset to almost zero and ready to measure the next bit of space information. R202 is adjusted so that any space pulse greater than 150 ms will charge C202 to the Schmitt Trigger (IC 201) firing point. When the Schmitt Trigger fires, its positive output pulse is conducted through D202 to charge C203.

R204 allows C203 to charge through D202 in 8 ms. Even if a mark pulse is received now and the output from Schmitt Trigger went to the zero state, C203 would remain charged because D202 would be reverse biased. C203 functions as a mark-hold or non-print memory. The positive charge on C203 is conducted through R205 and D206. This forward biases the selector magnet driver (Q202) and causes current to continuously flow through the selector magnet coils. This prevents the teleprinter from printing. The same positive charge that forward biased the SMD (Q202) also reverse biases D205. This allows the mark-hold memory to override input information from the PLL detector to the SMD. Q203 is a series gate that is normally biased on. It allows the positive space pulses to flow through D214, R207, and D204 to the autostart time constant formed by C204 and R214. When enough positive space pulses charge C204 to the second Schmitt Trigger (IC22) firing point it fires and goes to the high state and turns on the solid state teleprinter motor control relay. But when C203 is charged and puts the teleprinter in the print hold condition, part of its (C203) positive charge also forward biases D203 and this reverse biases Q203. When Q203 (series gate) turns off no further positive space pulses are allowed to flow to the autostart



Notes: Same as notes to Figure 2.

W.C.I. Patent Pending

Fig. 3. Anti-CW autostart.

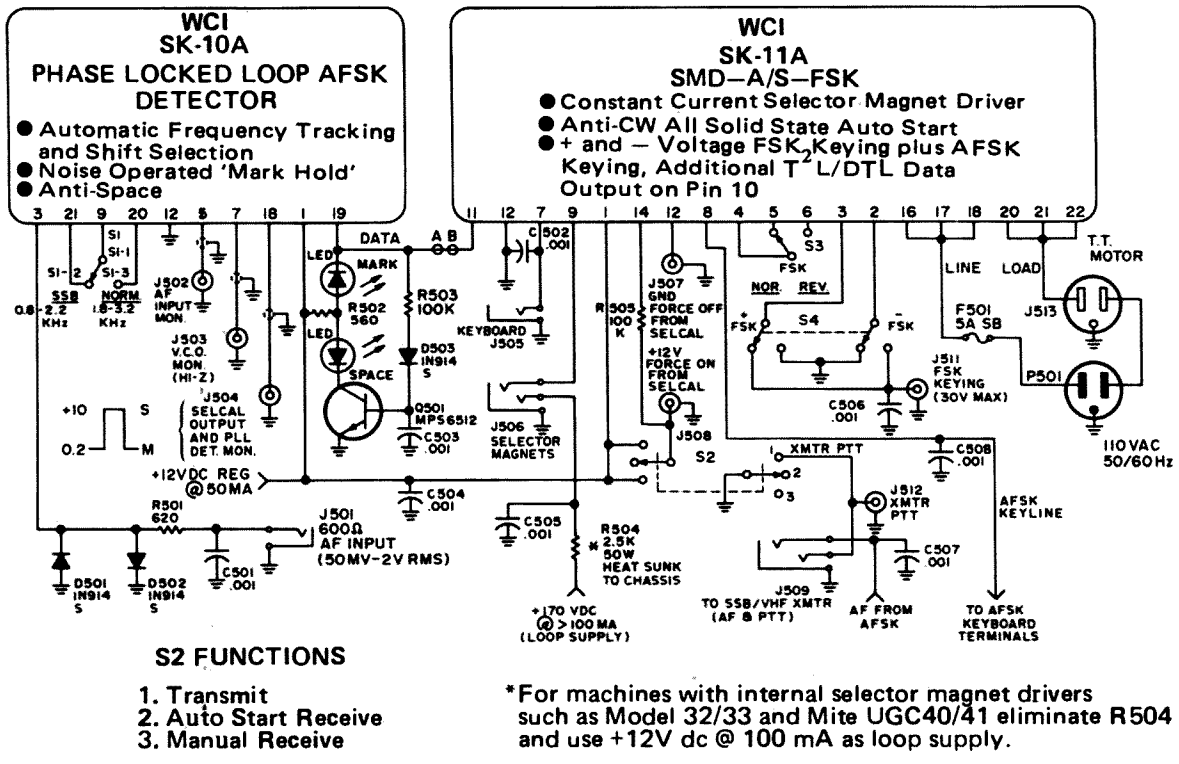


Fig. 4. Interconnect wiring.

RC circuit. Thus if the teleprinter motor is off it will stay off. If it is on, the lack of autostart positive space pulses will cause the printer motor to turn off in 30 seconds. Once the CW ceases, the TU will allow the teleprinter to go back to the print condition in 3 seconds after the last space pulse of more than 150 ms. At the same time the autostart gate is reopened.

A RTTY AFSK signal will turn the teleprinter on in 3 seconds. The teleprinter solid state motor control relay has a delayed dropout of 30 seconds. Even during this 30 second dropout time if a CW signal should appear in the upper capture range of the PLL detector the anti-CW circuit will function and place the teleprinter in a non-print condition.

AFSK–FSK Keying.

Keyboard outputs are provided to key an AFSK oscillator and an inverter option that keys an opto-electronic isolator that is used to key a negative FSK voltage. Such a voltage is found on the Signal One CX-7A. But provision is also made for keying a positive voltage FSK at the flip of a switch. The maximum voltage across the output of the opto-electronic isolator is 30V dc. An FSK reversing switch is also provided on the main frame wiring schematic.

Adjustments for the Anti-CW and SMD Card

There are only two adjustments so that a VOM and screwdriver will be all that is required. With the teleprinter connected, monitor TP-203 with the VOM and adjust R210 for a reading of 3.75V. This indicates a loop current of 60 mA. Then while receiving a 60 wpm RTTY signal, adjust R202 to the point where the machine occasionally goes into the mark-hold (non-print) mode and then back the pot off just a little. That's it; nice and simple. Now when you come back to read the copy on the teleprinter there will be no more "junque" caused by CW.

. . .W4FQM/1

NOTE 1. IC202 and 202 are by AMPEREX ELECTRONICS CORP.

NOTE 2. P.C. boards and built P.C. boards are available from WCI, P.O. Box 17, Schaumburg IL 60172.

EXTRA CLASS LICENSE STUDY GUIDE

Questions & Answers Part II

21. How does the beat frequency oscillator affect the tuning of a single sideband signal?

A. Extremely. The bfo signal takes the place of the original (and suppressed) carrier, and must be properly positioned. Thus the bfo tuning and the main tuning interact. With unselective receivers, the bfo pitch adjustment may be used for fine tuning. With narrowband receivers, the bfo should be set to place its signal at the proper point on the filter's passband, and the main tuning alone used to tune in the signal.

22. Can a lossy transmission line be used to transmit signals? Explain.

A. Yes. No matter how great the loss in the transmission line, at least a small part of the original energy will appear at the load end of the line. If losses are high, however, only a very small part of the input energy will appear at the output, and line efficiency will be low. If losses are sufficiently high and the line is sufficiently long, the energy appearing at the output will be insignificant. Thus at VHF, several hundred feet of lossy coaxial cable may be used as a highly efficient dummy antenna.

23. How can you distinguish between a product and an envelope detector?

A. The presence or absence of a bfo is a sure indication, in that every product detector requires a bfo. Thus if no bfo is present, the detector must be an envelope detector. However the converse is not true; many envelope detectors have bfo's associated with them to inject a local signal into the envelope prior to detection. In general, both detectors operate in the same way: each is a non-linear mixer circuit, which demodulates the incoming signal by mixing the sidebands with the carrier. Thus when the bfo is off, a diode detector acts as an envelope detector, while with the bfo turned on, the same detector is a product detector.

24. How can a receiver be adjusted for SSB reception when the receiver does not have a product detector?

A. See question 23. Strictly speaking, if the receiver is incapable of product detection it is incapable of receiving SSB signals as such. The SSB signal can be converted into one containing a carrier by external carrier injection, using the transmitter vfo or a separate signal-frequency oscillator.

In general, however, the term "product detector" is used for a special kind of product detection circuit tailored to best reception of SSB signals; many receivers which are capable of product detection do not have "product detectors" in this sense. With such a receiver, audio gain should be turned all the way up and output adjusted by means of the rf gain control (to assure that the SSB signal is weak, at the detector, in comparison to the bfo signal). The bfo should be turned on, and the signal carefully tuned using both main tuning and bfo pitch controls until the speech becomes recognizable.

25. How do mica and paper dielectric bypass capacitors compare at different frequencies?

A. Mica capacitors have much lower internal inductance than do paper capacitors, due to differences in their construction. The difference is negligible at frequencies below the broadcast band, and may be tolerated at frequencies up to 4 or 5 MHz, but as frequency increases, the paper capacitor behaves more as a coil than a capacitor and mica or ceramic units must be used. Mica can be used into the VHF range; ceramics can be used through UHF, with care.

26. Discuss the advantages and disadvantages of electrolytic versus paper filter capacitors.

A. For the same capacitance value and voltage rating, paper and electrolytic filter capacitors compare as follows: paper is bulkier and more expensive than electrolytic, but has higher leakage resistance and much better resistance to aging. The electrolytic capacitor has many disadvantages, including low precision of capacitance value, variation of value with age and applied voltage, sensitivity to polarity of applied voltage, and a tendency to dry out. These are all, however, of little importance in power-supply filter applications. Paper capacitors may have much greater inductance than electrolytics (which may be constructed in a non-inductive manner).

27. Where in a receiver circuit should a limiter/blanker stage be placed to provide maximum utility?

A. Since the limiter/blanker circuit's purpose is to remove sharp impulse noise spikes from received signals, and such spikes cause highly selective circuits to "ring," the circuit should be placed ahead of all highly selective circuits for best results. Such a circuit usually is placed between the first mixer and first i-f strip, as a compromise between circuit ringing and achieving enough amplification to operate the blanker.

28. What frequency should a crystal oscillator circuit be tuned to for maximum stability?

A. That frequency which provides the minimum amount of feedback voltage across the crystal, while maintaining oscillation and good "starting" qualities. Usually this will be a frequency somewhat higher than the crystal's operating frequency.

29. What are microwave frequencies? What type of oscillator is commonly used to generate microwaves?

A. The term "microwave" is a loosely defined concept referring to frequencies higher than the UHF region yet lower than visible light. In general, any frequencies above 1 GHz (1000 MHz) may be considered "microwave." Another term often used now for similar frequencies is "millimeter waves," which refers to frequencies with wavelengths measured in millimeters rather than meters.

Three types of oscillators are commonly used to generate microwaves. They are the magnetron, the klystron, and the traveling-wave tube (TWT). All operate on velocity principles, rather than the intensity principles used at more familiar frequencies.

30. What are some of the factors that affect the field strength of a signal from a radiated antenna?

Field strength is influenced by many factors. A primary factor is the amount of power applied to the antenna for radiation. Another is the distance between antenna and measuring point, since field strength falls off as the square of the distance. Still another is the directional pattern of the antenna, which determines what proportion of the applied power is radiated in any specific direction. Reflections and multiple transmission paths can cause variation of field strength with small changes of measurement position, and both atmospheric and ionospheric conditions can cause field strength to vary from day to day. Signal frequency plays a large part in determining how the other factors affect field strength. For this reason, field strength is almost impossible to predict, and must be measured for an accurate determination in any specific case.

31. What factors determine the frequency at which a quartz crystal will oscillate? List some of the advantages of using crystals in amateur equipment.

A. A quartz crystal's oscillating frequency is determined primarily by physical

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CORE SIZE	-41 Mix Green 'HR' 20 kc - 100 kc μ=75	-3 Mix Gray 'HP' 50 kc – 1 mc μ=30	-2 Mix Red 'E' 500 kc – 30 mc μ=10	-6 Mix Yellow 'SF' 10 mc – 90 mc μ=8	-10 Mix Black 'W' 30 mc -150 mc μ=7	-12 Mix Grn-Wh 'IRN-8' 60 mc – 200 mc μ=5	Outer Diameter (inches)	Inner Diameter (inches)	Height (inches)
T-200	$2.50	$2.75	$3.00	$3.50			2.000	1.250	.550
T-130	1.50	1.75	2.00	2.50			1.300	.780	.437
T-106	.95	1.00	1.00	1.50			1.060	.560	.437
T- 94	.70	.75	.75	.95			.942	.560	.312
T- 80	.55	.60	.60	.80	.90		.795	.495	.250
T- 68	.45	.50	.50	.65	.75		.690	.370	.190
T- 50	.40	.45	.45	.50	.60	.65	.500	.303	.190
T- 37	.30	.40	.40	.45	.45	.55	.370	.205	.128
T- 25	.25	.30	.30	.35	.40	.45	.255	.120	.096
T- 12	.25	.25	.25	.25	.25	.35	.125	.062	.050

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dimensions of the crystal and by the "mode" of mechanical flexure within the crystal itself, and also may be modified by temperature and by the external circuit to some degree.

The major advantage of using crystals in amateur equipment is that it provides the most stable resonator yet known, so that oscillation remains on the same frequency for the same crystal within very narrow limits. Other advantages include ease of frequency determination and the ability to switch from one operating frequency to another and return without tedious adjustment, by replacing one crystal with another.

32. Explain the properties of a quarter-wave section of rf transmission line. How would these properties change if the output ends of the section were short-circuited?

A. An open-circuited quarter-wave section of rf line has the properties of a series-resonant LC tuned circuit. That is, its impedance between terminals is very low (nearly a short circuit). Apparent Q of such a resonator is very high, and tuned lines are used in VHF transmitters as tank circuits.

A shorted quarter-wave section reverses its characteristics to those of a parallel-resonant LC tuned circuit, and offers high impedance (nearly open circuit conditions) at its input terminals. Such a line may be used as an insulator.

A quarter-wave line connected between two different impedances acts as an impedance transformer; the output impedance for matching conditions is equal to the line's impedance, squared, divided by the input impedance value. Conversely, line impedance in order to match must be equal to the square root of the product of input and output impedance values.

33. How should a wave trap be connected to a receiving antenna circuit to attenuate an interfering signal?

A. A parallel-tuned wavetrap should be connected in series with the antenna and receiver so that all incoming signals must pass through the parallel-tuned circuit before reaching the receiver. A series-resonant wavetrap should be connected across the

receiver's input terminals in parallel with the antenna, so that it shorts out the undesired signal. Both types of wavetraps may be used at the same time if desired. At VHF and above, quarter-wave line sections may be used as wavetraps (refer to question 32 for parallel between line sections and tuned circuits).

34. Why are synchronizing pulses transmitted with television signals?

A. To assure that the horizontal and vertical sweep rates at the receiver are the same as those at the transmitter, thus making certain that the electron beam is at the same spot on the picture tube face as compared to the camera's scanning beam at each instant during the transmission.

35. How may an amateur check his transmitter for spurious sidebands?

A. By use of a selective receiver. The transmitter should be operated at minimum power into a dummy load to avoid overloading the receiver's input circuits, and the receiver then tuned over a wide range (several kHz) either side of the transmitter's signal while normal modulation is applied. Spurious sidebands will appear as "splatter" or "buckshot," coinciding with voice peaks usually but not necessarily.

36. How can the safe power input to a crystal oscillator circuit be determined?

A. The "safe" power input, not to be confused with the "proper" power input, may be determined by operating the oscillator at various power levels, increasing power each time, and observing the output signal for 30 seconds or more at each level. When power input approaches the "unsafe" region, the heat generated in the crystal will cause its dimensions to change, thus making its output frequency drift. The more unsafe the condition, the more rapid the drift of frequency. "Proper" power input is well below the unsafe level; it is the minimum which will produce reliable oscillation.

37. Define the term decibel. How is the decibel used for voltage and power calculation?

A. The decibel is one-tenth of a "bel." The "bel," in turn, is a measure of the ratio between two power levels, and is the logarithm (to base 10) of that ratio. The mathematical formula defining the decibel (abbreviated dB) is:

$$dB = 10 \log_{10} \frac{P_2}{P_1}$$

DB are used to compare voltages, but the comparison is meaningful only when the voltage is converted to a power level unless both voltages appear across the same impedance. If both voltages appear across the same impedance, dB can be used with voltage ratios. Since power varies as the square of the voltage, the square of the voltage ratio must be used. This is accounted for in the formula by multiplying the log by 2, to produce the familiar 20-time factor.

A dB value of "0 dB" indicates that both powers are the same, or both voltages. a 3 dB ratio indicates that one power is twice the other, or one voltage is 1.414 times the other. A 6 dB ratio indicates 4 times the power or twice the voltage. A 10 dB ratio indicates a 10-to-1 power ratio or 3.16228-to-1 voltage ratio. A 20 dB value indicates a 100-to-1 power ratio or 10-to-1 voltage ratio.

The usefulness of the dB system of measurement lies in the fact that it measures a ratio rather than absolute values, and almost all measurements and calculations to which it is applied are affected much more by ratio than by absolutes.

38. How are the emitter, base, and collector of a transistor biased for amplifier operation? How are they biased for cutoff (open circuit) and saturation (short circuit)?

A. For amplifier operation, the base-emitter junction of the transistor must be forward biased (conducting) while the collector-base junction is reverse biased (non-conducting). Bias values and the amount of current injected into the base-emitter junction are chosen so that conduction occurs between collector and emitter, and the amount of conduction which occurs is determined by the value of base current.

In switching operation, to achieve cutoff the base-emitter junction is reverse biased (non-conducting) which blocks vir-

tually all conduction in the collector-emitter circuit. Saturation is obtained by forward bias of the base-emitter junction, with injection of maximum current. In both cases, the collector-base junction is reverse biased.

Note that the only difference between amplifier operation and the saturation condition is the amount of current injected into the base-emitter junction. With some types of transistors, no reverse bias is necessary to achieve cutoff; merely reducing the injection current to zero does the job.

Transistors designed for amplifier use are built to operate best in the transition region between cutoff and saturation; those designed as switches are built for minimum resistance in saturation with maximum resistance at cutoff, and properties in the transition region may be neglected. However many devices designed for one purpose work well for the other, and vice versa.

39. How do NPN type transistors differ from the PNP type? How does their bias differ?

A. Transistors always consist of two types of semiconductor material in three regions, forming the emitter, base, and collector. The types of material are "N" type, which has an excess of electrons, and "P" type, which has a shortage.

An NPN transistor uses N-type material for emitter and collector, with P-type for the base. A PNP, on the other hand, uses P-type for emitter and collector, and N-type for the base.

Polarity of all bias connections is reversed from one type to the other. For instance, an amplifier circuit in the conventional common-emitter configuration may have the emitter grounded, with negative bias going to both collector and base through appropriate resistors, to establish the required bias conditions for a PNP transistor. If an NPN is used in the same circuit, the bias polarity must change from negative to positive.

40. How can the output circuit of a transmitter be adjusted to increase or decrease its coupling to the antenna system?

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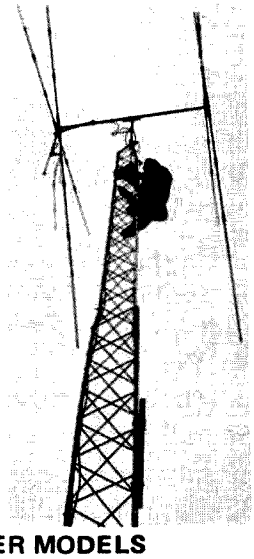
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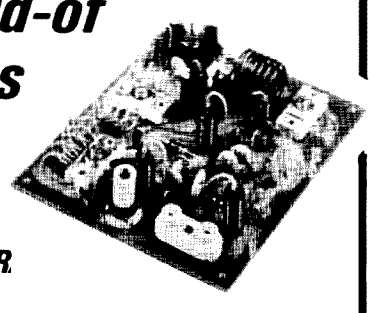
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of man-made signals such as "ignition noise" or the "static" caused by sparking at the contacts in electric motors. Electrically, however, these are signals; "noise limiters" deal with these unwanted signals, which are most usually generated by the sudden interruption of current flow which may or may not be accompanied by a visible spark.

Natural "noise" is a random change of energy level, which is more or less evenly distributed across the electromagnetic spectrum, and is not "coherent" (that is, it has no specific frequency as such). In the audio range, it manifests itself as a hiss or frying sound.

Such noise is basically due to the statistical unpredictability of energy-level changes within the individual atoms which go to make up the universe, and because of this is always present. In amateur practice, it is generally characterized by its apparent origin. Thus we have, for example, "antenna noise" which is present with the signal when it arrives from the antenna. This is, in turn, composed of "galactic noise" which arrives from outer space, "atmospheric noise" which originates within our own atmosphere and ionosphere, and "thermal noise" which originates within the conductors of the antenna and feedline (as well as within the components of the amplifier's first rf amplifier stage). Noise of this sort is always proportional to temperature; the higher the temperature, the greater the noise voltage. In fact, in radio astronomy noise levels are measured in "degrees Kelvin" which are a measure of the temperature of the apparent noise source.

Besides antenna noise, we have "receiver noise," which includes thermal noise in the components ahead of the first rf stage, "shot noise" in the tube or transistor of the first stage, "partition noise" from multi-grid tubes in the rf amplifier chain, and "mixer noise" contributed by the mixer stage(s).

All these noise voltages, except for man-made "noise" signals, are very low, but with the high amplification available in most receivers, provide a lower limit to the receiver's sensitivity.

A. The output coupling adjustment depends upon the type of output circuit used. A pi-network output circuit's coupling is determined by the output capacitor; the more capacitance, the less the coupling. A link-coupled circuit is determined by physical coupling of the link to the final tank; the closer, the greater the coupling.

41. How do filters attenuate harmonics emissions?

A. We assume that the question refers to low-pass filters, since high-pass filters would not attenuate harmonics, and a bandpass filter would reduce harmonics in the same way as does a low-pass unit.

The filter consists, then, of one or more sections which contain series inductance and shunt capacitance. Reactance of the inductance rises with frequency while that of the capacitance falls. The harmonics being at a higher frequency than the desired signal, their energy is opposed by the increasing reactance of the inductance, and finds a ready path to ground through the reduced reactance of the capacitance.

In some cases, resonant circuits are employed to trap out specific harmonic frequencies. Refer to questions 32 and 33 for discussion of wavetraps.

42. List several advantages and disadvantages each for Class A, Class B, and Class C amplifier operation.

A. Class A offers greatest linearity (least distortion) and simplest adjustment during operation, but is least efficient in use of input dc power and is limited in power-handling capability.

Class B offers improved efficiency and power output capacity, but at the cost of increased distortion and critical adjustment.

Class C has highest efficiency and relatively uncritical adjustments, but inherently distorts the signal and so cannot be used when the signal envelope must be preserved. It also produces much greater harmonic output.

43. What are some different types of noise voltages encountered in amateur receivers? How is each type generated?

A. The word "noise" may be misleading, because much "noise" actually consists

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44. What are current and voltage characteristics along a transmission line when it is matched and mismatched?

A. Assuming that the line has losses so low that they may safely be neglected, in a matched line the current will be the same at any point, and so will the voltage.

When a mismatch exists, the current and voltage values will vary cyclically along the line, repeating every half-wave along the length of the line, and current and voltage will not necessarily be in phase with each other. The ratio between minimum and maximum is expressed as "standing wave ratio," and is proportional to the ratio of mismatch. That is, a 50Ω line terminated in 100Ω will display a 2-to-1 ratio between maximum and minimum voltage, and has a VSWR of 2.0.

45. How do receivers for remote control of objects and regular type communications receivers differ in basic operation?

A. Normal communications receivers are intended to provide information to human beings, and normally do so in the form of audio signals through headphones or loudspeakers (although an RTTY station does so via printed words on paper). Remote-control receivers, on the other hand are intended to provide information to machines to control their actions, and normally do so without output transducers such as phones, speakers, or printers, by means of electrical signals which directly actuate the controls.

In addition, communications receivers usually offer continuous tuning over several frequency bands, if not the entire spectrum, while remote-control receivers are usually fixed-tuned on a limited number of channels. However, some commercial communications receivers (such as those used in aircraft communication) are fixed-tuned, while nothing prevents incorporation of continuous tuning in a remote-control receiver. The output-signal distinction is the defining difference in characteristics.

This marks the half-way point in the FCC study list. Questions 46 through 90 will be continued in June *73*.

.Staff

Peter A. Stark K2OAW
196 Forest Drive
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A MODERN VHF FREQUENCY COUNTER



Part 1 of 3 parts

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Although a number of frequency counter designs have appeared in *73* and elsewhere, we decided it was time to come up with a new design. We have gone out of our way to make the building of this counter as easy as possible, and yet to produce a counter of really top-notch performance. The complete information you need to build your own counter will be presented in three parts. This month we will give a complete description of what the counter is and what it can be used for, as well as the complete parts list so you can start collecting parts if you decide to go ahead. Next month we will give the complete logic diagrams and theory of operation. The month after that we will have the printed circuit board layout, parts layout drawings, and construction and operating information.

And now a little information about the counter:

1. The basic counter measures up to 20 MHz, although many IC's go past that. One of our prototypes goes up to 35 MHz, and the other goes to about 40 MHz. But that's only the basic counter – an optional VHF pre-scaler mounts on the same board and extends coverage to above 200 MHz. Depending on the IC's, you may get operation higher than that. We've had our prototype counting at the upper limit of our signal generator, which is 250 MHz. With a simple modification, the scaler range can be increased to typically 320 MHz though at reduced sensitivity.

2. It is easy to build. Except for the power supply, all other small parts fit onto one 7 x 10 in. printed circuit board. This means there's a minimum of external wiring and less chance for error. The p.c. board layout, etched boards, and complete parts kits are available to make the job even easier.

3. The resolution is within 1 Hz with the basic counter up past 20 MHz, and within 10 Hz with the VHF scaler. The accuracy depends on the quality and type of reference crystal used; the circuit allows you to zero-beat the crystal against WWV. With the AT-cut series-resonant crystal suggested the specs say that the drift should be less than 0.5 parts per million (ppm) per month (equivalent to about 75 Hz at 2 meters) and

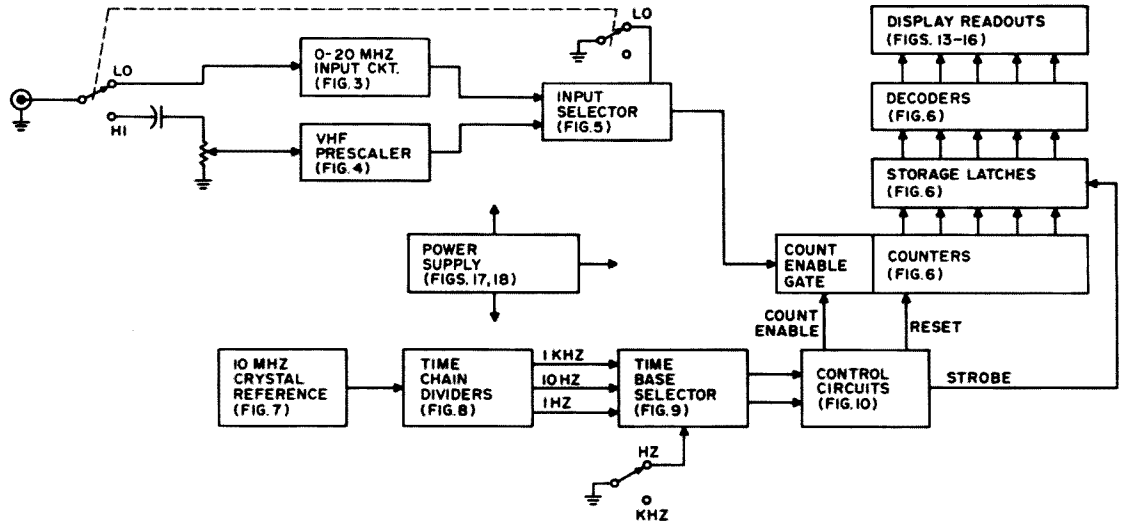


Fig. 1. Counter block diagram.

the temperature coefficient should be about 0.077 ppm per degree Centigrade (about 12 Hz at 2 meters). In our counter the crystal is mounted close to the edge of the p.c. board with the idea that someday we will place it in a crystal oven. Let's face it – the measurement accuracy is only as good as the reference crystal accuracy, and all the really expensive commercial counters have crystal ovens. (The Heathkit doesn't and it drifts with temperature.) Although we will not describe an oven in this article, we suggest you keep it in mind for that certain "someday."

4. The design is really up to date. It uses the latest TTL and ECL integrated circuits. To simplify construction, complex MSI (Medium Scale Integration) IC's are used to reduce the number of interconnections. Although the board is laid out for Numitron readout tubes, light-emitting-diode (LED) readouts can be used to provide state-of-the-art reliability as well as really snazzy looks.

5. The price is really reasonable. Complete with all parts, including cabinet line cord and all the other necessary things so often forgotten in parts estimates, the entire counter *with* VHF prescaler will cost you about half of what you'd pay for the cheapest commercial units, including kits. Here's how the price breaks down into the various portions of the counter.

a. Basic counter circuitry including all IC's and small parts, but not including VHF prescaler, readout indicators, and power supply – about $65.

b. Power supply – about $15.

c. VHF prescaler, optional – about $25.

d. Readout indicators and associated circuitry.

The price depends on which indicator type you choose. Numitron readouts will add about $25, miniature incandescent readouts (sometimes called Minitrons) will cost about $20, and LEDs will cost about $35 (prices from one source dropped to $6 per LED at the time of writing, and we expect other dealers to follow suit.) Though the Minitrons are the cheapest, we don't really recommend them since the $5 saving over Numitrons doesn't justify the added work. Numitrons are viewed from the side, and plug right into the p.c. board. In this way you can read the digits from the front of the board. The Minitrons, on the other hand, are viewed from the top. This means you need a separate p.c. board, mounted at right angles to the main board and in front of it, to provide a convenient readout. Those two boards will connect to each other with 38 wires! Incidentally, the LEDs mount the same way, but that's the price of progress.

e. Cabinet, input connectors, test leads, assorted hardware etc. – about $15.

These prices assume you have to go out

and buy all new parts, though not necessarily from a dealer who charges list price. Quite a few of the IC's are available at below-cost prices from a number of mail order outlets around the country, and we used these prices in calculating the total price.

If you have a modest sized junk-box, you may be able to shave these prices a bit, but don't expect miracles. Unless your junk-box is very modern, it probably won't contain too many useful parts aside from things like switches, connectors, fuse and line cord, and the like. Still, it seems quite reasonable that with a little effort you could build the complete counter with Numitron readout but less VHF scaler for less than $100, and for about $125 with it. This is roughly half or less of the price of the Heathkit counter or counter/scaler combination. And it isn't much more than some commercial VHF scalers alone.

Interested? Then let's get on with the description. Figure 1 shows a fairly complete block diagram of the entire counter. The individual diagrams for each block will be shown next month, and the block diagram gives the figure number for the detailed diagram.

The input signal is fed by the HI-LO switch to either the 0–20 MHz input circuit, or to the VHF prescaler. The low frequency input circuit just converts the input signals into digital pulses, while the VHF prescaler divides the input frequency by 10 to bring it into range of the rest of the counter circuitry. The outputs of these two circuits are sent to the input selector, which selects one input and sends it on to the count enable gate, which is part of the counters. The count enable gate is opened by the control circuits for a specified length of time, and the number of cycles during that time is counted by the counters. The count is then transferred into the storage latches, which hold the count while the counters take the next count, to produce a non-flickering display. The output from the storage latches goes to the decoders, which then feed the display readouts. The display shows a five-digit number and has an over-range light if the count exceeds five digits.

The time reference for the count enable gate comes from a 10 MHz crystal oscillator,

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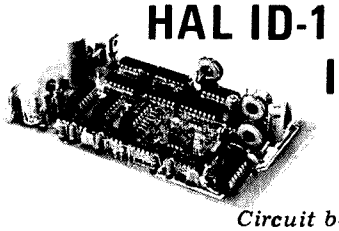
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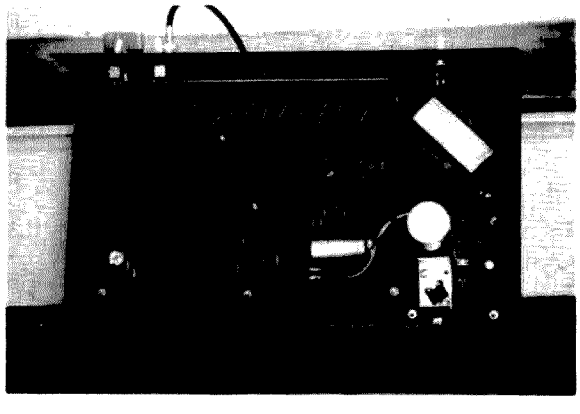
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whose output is divided by seven decade counters in the time chain divider circuit, to produce 1 kHz, 10 Hz, and 1 Hz pulses which go to the time base selector. The selector chooses the correct frequency pulse train, and sends it to the control circuits.

The control circuits govern the basic timing of all functions of the counter, and generate the count enable, strobe, and reset signals, in that order, over and over. Thus the counters are allowed to count for a certain amount of time, then the count is transferred (strobed) into the storage latches, the counters are reset back to zero, and then the count enable comes again for the next count.

One of two measurement periods is selected by the Hz-kHz switch. Assuming that you are not using the VHF scaler, the Hz position of the switch results in a count enable signal lasting exactly one second. Thus the counters count the input frequency for exactly one second, and the five-digit display then shows the right-most five digits of the total count, up to a maximum of 99999. If the actual input frequency is higher, the readouts still show the right-most five digits, but an over-range light indicates that there are more digits to the left. For example, suppose the input frequency is 1,234,567 Hz. Then the readout shows the digits 34567 and the over-range light is on.

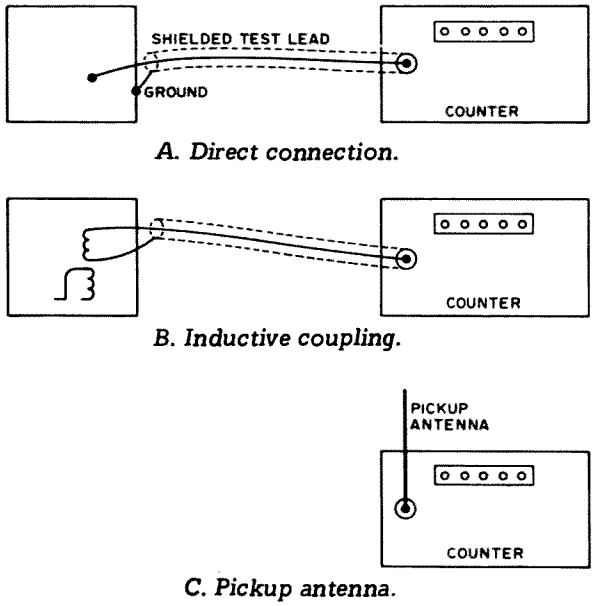
If we want to see the digits to the left, we just move the switch to the kHz position, which selects a count enable period of 1/1000 second (1 millisecond). If the input frequency is 1,234,567 Hz, then there will be 1,234 cycles in that millisecond, and the readout will show the digits 01234. Put the two readings together, and you have a readout down to the last cycle.



Top view of counter.

Using the VHF scaler, all input frequencies are divided by 10. For example, if we want to measure a 146.940123 MHz signal, the scaler converts the frequency to 14.694012 MHz. In the kHz position of the Hz-kHz switch we will have a readout of 14694, while in the Hz position we will get 94012 with the over-range lamp lit. Thus we have resolution down to 10 Hz.

While it may seem a bit inconvenient to have to use two readings to get an accurate frequency indication, there are two good reasons for doing it this way. First, to get the frequency in just one reading, we would need an 8-digit readout instead of five. That means three more counters, three latches, three decoders, and three indicators. That's an increase of 60% in price in that part of the counter. If price is no object, it's easy to add the extra parts yourself.



A. Direct connection.

B. Inductive coupling.

C. Pickup antenna.

Fig. 2. Coupling the counter to external equipment.

The second reason is that to get an accurate readout down to the last cycle (or last ten cycles with the VHF scaler) takes a whole second of counting. If you don't need that accuracy, that's a relatively long time. In the kHz position we get a new reading every 1/10 second, which really speeds up the process, especially if the frequency is changing and you want to follow the change.

Before we get on to the parts list, it might be a good idea to look at some applications of the counter. Figure 2 shows some typical

ways to connect the counter to a circuit to measure the frequency of a signal. Just because measuring the frequency of a 2-meter FM rig is the most obvious, we'll leave that for last.

Figure 1A shows the easiest way - connecting directly into a circuit. The low-frequency input circuit on the counter has an input impedance of about 1 MΩ, shunted by less than 20 pF, approximately. The VHF scaler has an input impedance of 50Ω. But avoid overdriving the inputs to avoid damage. The low-frequency input can stand voltages up to about 100V peak, though it may not count well at inputs over 20V. The VHF input uses a 50Ω attenuator, and you should make sure not to overdrive the input stage, since this may damage the input circuit or slow it down (for highest speed it's necessary to keep the input transistors from saturating, which means keeping the level just above the point where the counter just starts counting). The best habit here is to start with the attenuator at minimum and turn up just enough to get a good reading.

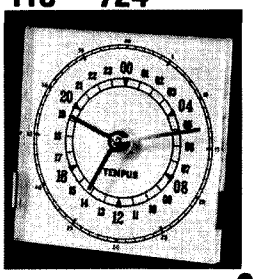
It's hard to give a sensitivity figure for both inputs since we don't have voltmeters capable of measuring at rf frequencies. But it appears that the low-frequency input needs about 200 mV rms, and the VHF input needs about 400 mV. Incidentally, both inputs have input isolation capacitors, so the counter can be connected to a point where a small dc voltage is present. But watch out, and don't exceed the breakdown voltage of the capacitor you use. This limits the low-frequency input to frequencies above about 20 Hz; if you want to go below that you will just have to increase the value of the isolation capacitor, or remove it altogether.

Using the direct connection, we've been able to measure the frequencies in tube-type equipment as well as low-level transistor circuits. But don't try to connect the counter to your power amplifier! A very useful way of putting 2-meter gear on frequency has been to connect the counter to the output of the oscillator, and measure the frequency right there.

When you have a high-power stage, or a stage where you don't want to make a direct connection, the best way is with an inductive loop as shown in Fig. 1B, much like a

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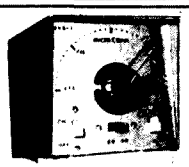
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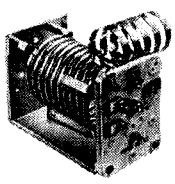
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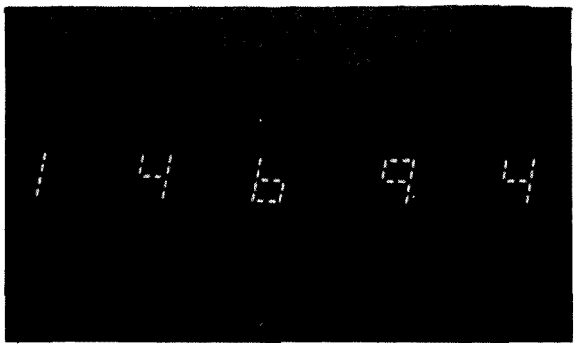
wavemeter would be used. If you are working with a high-power stage, start with the counter loop far away, and only gradually bring it closer until you just get a reading. A very useful coil to use as the pickup loop is a coil from a grid-dipper (GDO).

Incidentally, we have found that the counter makes the GDO into an extremely useful device. The problem with most GDOs (and signal generators as well) is that their frequency calibration is terrible. But the counter solves all that – just take the next higher frequency GDO coil, connect to the counter, and use as the pickup loop, an inch or so from the GDO coil. By measuring the actual frequency your GDO is putting out, you can align a tuned circuit right on. To find out the frequency of an unknown received signal, just beat the GDO against it and read the frequency. If the GDO doesn't go that high, use a harmonic. For example, we wanted to find out the frequency of a signal in the 160 MHz public service band. We tuned in the signal on a cheap VHF monitor radio, beat the tenth harmonic of a 16 MHz signal from the GDO against the unknown, and read the 16 MHz frequency on the counter. Multiply by ten, and you have the right value, and you don't even need the VHF scaler.

Another application along the same line comes when you have a real low-level stage, where there just isn't enough signal to count the frequency directly with the counter, or where there are several frequencies at the same time, as in a reflex amplifier. We solved that by plugging an earphone into the GDO, zero-beating it against the unknown, and reading the GDO frequency with the counter.

Finally, Fig. 1C shows how to measure the frequency of a transmitter – just connect the counter to another antenna near the transmitting antenna. We've used this approach at 2 meters, with a 19-inch piece of wire connected to the counter. We've been able to measure the frequency of a 1W handie-talkie about five feet away, which shows that the sensitivity is quite good.

To end the overall description of the counter, the parts list provides a complete list of everything you need to build the counter. The parts list is divided into 5 parts.



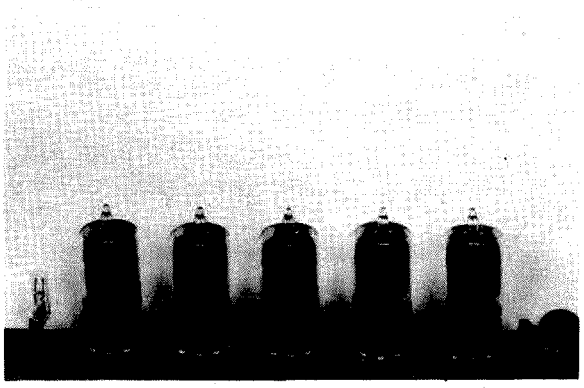
LED readouts.

Part A has all the basic counter parts except for the readouts, the VHF scaler and the power supply. All of these parts fit on the main 7 x 10 in. printed circuit board, except for the Hz-kHz switch which mounts on the front panel.

Part B describes the power supply, which provides a regulated +5V ±5% at about 1.5 amperes and +25V unregulated at about 10 mA. There's quite a bit of room for experimentation here, but make sure that the +5V supply voltage is well regulated. The diodes and filter capacitor for the +25V supply mount on the main p.c. board, but the +5V supply mounts separately. We did not design our own p.c. board for the +5V supply, since a number of commercial supplies and kits are available.

Part C describes the optional VHF scaler. Except for the 50Ω input pot and the HI-LO switch, all of these parts also fit on the main p.c. board, and can be added at any time.

Part D lists the parts for the readouts, with a choice of either Numitron, Minitron, or LED readout. (You could substitute NIXIE® tubes, but then you'll have to redesign the p.c. board since different IC decoder/drivers are needed.) The Numitron



Numitron readouts.

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readouts mount right on the main board, using 9-pin miniature tube sockets.

Minitron and LED readouts need a separate board to hold the readouts. For the Minitron you can use perf-board with holes on 0.1" centers. The LED readout, however, needs 150Ω current limiting resistors, and so we have designed a 3 x 7 in. p.c. board to hold the five LED readouts, the current limiting resistors, and a single red LED diode for the over-range indicator.

If you use the Numitrons or Minitrons, you will need a separate 3V lamp power supply, as well as a driver transistor for the over-range lamp. Except for the lamp supply power transformer, all other components mount on the main p.c. board.

Finally, part E of the parts list gives some of the miscellaneous parts you will need to complete the counter. As far as the cabinet is concerned, you're on your own. Our prototype (shown in the photos) used a Bud "Tilt-a-View" cabinet (TV-2155) but this cabinet is a lot bigger than you need. We wanted to leave everything open so it would be visible on the photos, but the counter can be crammed into a small cabinet, with the power supply stacked above or below the main board.

Next month we will continue with more information. . . .K2OAW

FREQUENCY COUNTER PARTS LIST

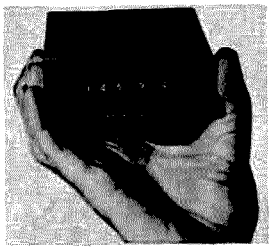
A. Basic counter – less readouts, scaler, power supply

12	SN7490N	TTL decade counters
4	SN7400N	Quad 2-input TTL nand gate
5	SN7475N	Quad TTL latch
5	SN7447N	BCD-to-decimal TTL decoder/driver
2	SN7473N	Dual TTL J-K flip-flop
1	SN7476N	Dual TTL J-K Flip-flop
1	SN7413N	Schmidt trigger TTL
1		10-MHz AT-cut series resonant HC-18/U crystal
1	1.7–14.1	pf variable air capacitor (Johnson 189-505-5
1	40673	RCA dual-gate-protected FET transistor
2	2N5172	NPN transistor or equivalent
1	7 x 10 in.	printed circuit board – see part 3 of article
1	5K	pc mount potentiometer (CTS X-201-R502B or equiv)
2	220Ω	¼ watt 10% resistor
1	560Ω	"
1	1K	"
1	1.8K	"
1	2.2K	"
2	4.7K	"
1	10K	"
1	27K	"
1	100K	"
2	1 Meg	"
1	4.7K	½ watt 10% resistor

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COMING SOON: A frequency synthesizer for 45 MHz. receive crystals, a combination transmit and receive synthesizer, a synthesizer with direct output in the 144 and 220 MHz. band, and a whole series of synthesizers to cover from sub-audio to microwave frequencies.

IMPORTANT: When ordering be sure to state if you want the 6, 12 or 18 MHz. output.

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1	33 pF	NPO disk capacitor
2	100 pF	disk capacitors
14	0.01 μF	"
6	0.1 μF	"
450		MOLEX IC socket pins (used instead of IC sockets)
1		SPST switch (Hz-kHz switch)

B. Power Supply

1		Transformer, 6.3V 2 amp and 38V CT 50 mA
2		500 mA 100 PIV rectifier diodes
1		1000 μF 50V electrolytic capacitor
1		SPST on-off switch
1		line cord
1		½ amp fuse and fuse holder
4		2 amp 50 PIV rectifier diodes
1		5000 μF 15V electrolytic capacitor
1		100 μF 15V electrolytic capacitor
1		0.1 μF disk capacitor
1	LM-309K	IC 5V voltage regulator, TO-3 can
1		heat sink for above, minimum 2 x 4 in., finned

C. VHF Scaler (optional)

1	μ6B958259X	Fairchild ECL amplifier IC
1	μ6B95H9059X	Fairchild ECL scaler IC
1	SN7400N	TTL Quad 2-input gate
32		MOLEX pins
1	2N5771	Fairchild PNP switching transistor
7	0.01 μF	disk capacitor
2	0.1 μF	"
1	50Ω	panel-mount carbon pot (Allen-Bradley JA1N056S500MA or equivalent.
1	2K	p.c. mount potentiometer (CTS X-201-R252B or equiv.)
1	120Ω	¼ watt 10% resistor
2	10K	"
2	330	"
6	220	"
1	4.7K	"
1		DPDT switch (HI-LO switch)

D. Readout Indicators – choice of D-1, D-2, or D-3

D-1 Numitron Readouts

5	DR-2010	RCA Numitrons
5		9-pin p.c. mount tube sockets
1*	5V 30 mA	bulb (Sylvania 5ESB or equiv) with matching lampholder and lens
1*	6.3V 1 amp	filament transformer (center-tapped)
2*	1 amp 50 PIV	rectifier diodes
1*	10K	¼W 10% resistor
1*	2N5172	NPN transistor or equivalent

D-2 – Minitron indicators

5		Minitron readouts
5		16-pin IC sockets

Plus all starred components from D-1 above, and a circuit board.

D-3 – Light-emitting-diode readouts

5	LED	Readouts. (Monsanto MAN-1 or MAN-3, Litronix 10A, Environmental LED-700, or equivalent)
35	150Ω	¼ watt resistor 10%
1		red LED overrange indicator
1	220Ω	¼W 10% resistor
50		MOLEX pins
1	3 x 7 in.	p.c. board for LED readouts

E. Miscellaneous

Cabinet – Input connector – Test leads – Line cord strain relief – Bezel or polarized glass in front of readouts – Hardware.

NOTE: Board layouts are available from the author. Etched and drilled boards are available from Ionic Industries, Criss Circle, Elk Grove Village, IL 60007. Boards, IC's and other parts are available from Circuit Specialists, Box 3047, Scottsdale, AZ 85257: $70 for drilled PC board, IC's and all active devices.

EXTRA!

OSCAR MARINER ONE IS ON THE PLANET MARS

by Keith E. Lamonica W7DXX, special to 73 Magazine

Well it took a long time but OSCAR Mariner 1 is now on the planet Mars and operating well. As you recall, space became available for the OSCAR package on the last unmanned NASA mission to Mars. Dr. Bernard Wizenhoff called OSCAR headquarters and told the group the good news. He said, "Gentlemen, we are launching Mariner 34 to the planet Mars when the next launch window is available for the shot. It will be between January 11 and 18th. We will place three Bromar type capsules in synchronous orbits around the planet and an LSVL (Life Support Verification Lab) on the planet's surface near the Nodus Gordii crater complex." Dr. Wizenhoff continued, "We have room for a 12-pound package from the OSCAR boys."

Dr. Wizenhoff and NASA had given amateurs around the world a chance to study Mars. However, a great deal of work had to be completed in a short period of six months. It had been hinted three years ago that space on a Mariner mission would become available so a great deal of thought had been put into a possible OSCAR mission to Mars. These were to be the main objectives of OSCAR Mariner 1:

1. The capsule would have a 450 MHz beacon transmitter on 444.1
2. The capsule would have a 1250 MHz to 144.1 repeater
3. The capsule would incorporate a general coverage receiver that would automatically scan from 500 kHz to 10 MHz and retransmit any signals found to 1250 MHz
4. The capsule would make use of a small atomic generator donated to OSCAR by NASA.
5. The capsule would transmit slow scan video signals during approach, descent, and after landing on Mars.

This was to be an extremely ambitious program that looked good on paper and would now be put to the test. OSCAR Mariner 1 had to be designed, built, and ready for launch in *six months*.

Howard W6UOV and his group would concentrate on the 450 beacon and 1250 to 144 repeater. The boys at OSCAR in Europe would design and build the general coverage receiver with auto scan. The engineers at NASA agreed to install the atomic powered generator and television camera. We were informed that the television camera would be on loan only. I can't figure out how they intended to get it back since all manned flights to Mars had been cancelled after the strange goings on with the manned Mariner 16 and 21 missions. As you recall, NASA cancelled all manned flights to the surface until a more complete study could be made of the strange lights and mental confusion. The crew of Mariner 16 had an excellent flight to Mars and everything went very well until their first rest period while in a parking orbit around the planet. The crew was awakened from their rest period by strange pulsating lights coming from the outermost moon of Mars, Demos. Although the crew claimed it looked like a sort of code, NASA claimed the lights were some form of natural phenomona (maybe swamp gas). The lights stopped after about 3 hours and the crew prepared to leave their parking orbit and land on the planet Mars. When the crew landed near the Nodus Gordii crater complex they were met with what they could only describe as "mental confusion." As one crew member described it: "As soon as we touched down it was like opening a door to hell. My mind was going in circles. I had trained for years for this mission. I had my list of objectives and sequence of events firmly planted in my mind but as soon as we hit the planet, all I could think of was how fast I could get out of here."

Well, we all know how the mission ended. After 3 hours on the surface of Mars the crew took off and returned to earth. The official NASA explanation was that "due to the great strain of many weeks in space in a weightless condition the crew suffered mental breakdown when they approached Mars."

Anyway, back to OSCAR. Since none of the previous unmanned missions to Mars had met with any difficulty, other than camera failure on most missions, it was decided to incorporate as much scientific equipment into the OSCAR capsule as possible.

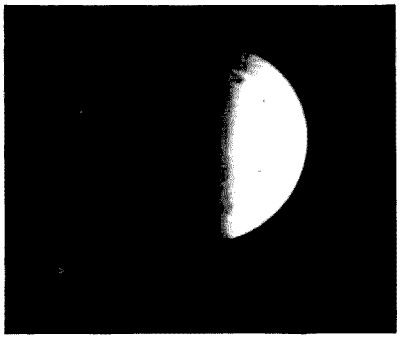


Photo 1



Photo 2



Photo 3

Through extraordinary cooperation and many sleepless nights in the building of OSCAR Mariner 1, he was ready for a checkout one week ahead of schedule. The entire package was installed aboard a twin engine Comanche aircraft and flown around the southern California area. OSCAR worked well, relaying pictures of the ground below while sending out the 450 beacon and repeating 1250 MHz to two meters and sending out telemetry data on environmental conditionn (we did not include a smog detector for southern California). The only problem with OSCAR turned out to be minor. The 450 MHz beacon was shifting in frequency and the power was down. The problem with the beacon was so minor that it was repaired while in the aircraft. OSCAR Mariner 1 was ready to meet Mars.

After several days of frustrating "holds" at the Cape, a Thor Monarch combination blasted OSCAR toward space.

After several months in space OSCAR was approaching Mars. While inside the main rocket, OSCAR was controlled through NASA. All commands and telemetry were received and relayed through the big NASA "dishes" around the world. Three hundred thousand miles from Mars OSCAR was given the command to turn on the camera and telemetry transmitter. Back came a strong signal indicating OSCAR was well and that pictures were being taken of Mars. It would be 15 minutes before we would see the first pictures from OSCAR since the slow scan television camera records the pictures on tape and then sends each complete set at once. The 15 minutes dragged on until finally the 1250 carrier appeared indicating a picture was about to be sent. However, all we heard was the carrier – no pictures. A command was sent to OSCAR to send back a status report. Evidently the on-board computer had become confused and erased the pictures before they were sent. Normally, after each picture series is sent back, the ground crew sends a command to OSCAR which in effect says, "We received the last set of pictures. Now erase your tape and start recording a new set of pictures." Anyway, the computer was confused and got the sequence out of order.

A new command was sent to take a new series of pictures and not erase the damn things this time. After another agonizing 15 minutes passed, the big screen at NASA came to life and the first picture from OSCAR started to take form. Slowly the picture took form as the tape played back the picture frame by frame. What started as a couple of white lines across the top of the screen turned into a large white ball – the planet Mars. After computer enhancement picture one shows the planet Mars from a distance of 300,000 miles. A great first for amateur radio operators around the world. The picture shows Mars during one of the planet's dust storms. During these storms wind velocity exceeds *500 mph*.

As OSCAR approached the red planet and went into a parking orbit more pictures were taken. Picture 2 is rather spectacular. The dark spot in the lower right hand corner of the picture is the innermost moon of Mars, Phobos, as it crossed the planet's surface. Several pictures were taken of Phobos. Picture 3 shows it to be a very old and rugged moon. In the upper corner of the picture you can see where part of the moon has been torn away – probably due to an impact with a large meteor.

As OSCAR left the parking orbit for a ride down to the surface of Mars, the cameras were rolling. In a series of pictures during the approach (pictures 4, 5, 6, and 7) one can see the polar ice caps of Mars and many of the larger Martian craters. Picture 8 shows the landing spot of OSCAR. This picture taken a few minutes before touch down shows the Nodus Gordii crater complex and an "X" marks the actual point of touch down.



Photo 8

After impact OSCAR was commanded to extend his antennas and all equipment, which he did beautifully. Now instead of having to be relayed through NASA, OSCAR's signals were coming directly from Mars to Earth. The first signals were very strong – in fact somewhat better than those relayed through NASA. Immediately OSCAR began transmitting the 450 MHz beacon, repeating 1250 MHz to 144.1, and scanning the planet for signals in the 500 kHz to 10 MHz range and retransmitting them back to Earth. Signals from the 1250 to 144.1 repeater were strong and steady. Hundreds of Earthside amateurs were communicating via a repeater on Mars. The activity was so immense that Wayne Green W2NSD/1 immediately suggested we split the channels into 600 kHz segments. The repeater is broad band allowing twenty-five to thirty conversations at one time.

At this time, no other pictures have been received from OSCAR. Somehow the computer on board is pulling its old trick of erasing the pictures before they are sent. The repeater is going well, as is the LSVL system. All systems have a life expectancy of at least one year. The LSVL system reports back that Mars is much friendlier than we at first thought.

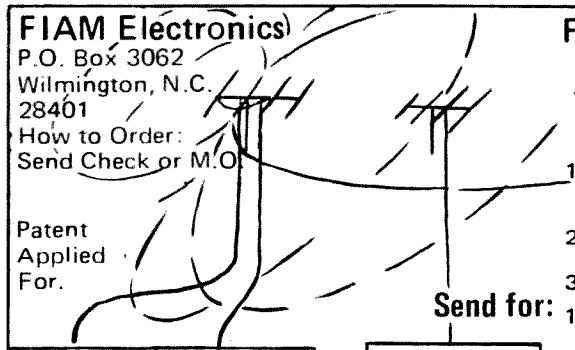
OSCAR tells us that the atmosphere of Mars can possibly support life as we know it . . .



Photos 4, 5, 6 and 7

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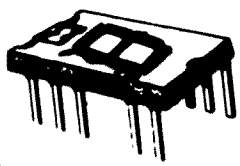
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I operate mobile a good bit, and I like the ability to move from one end of the band to the other. Also, when I move the rig between my two cars I take the Hustler resonators with me.

All this calls for retuning the resonators for a low swr, which is time consuming.

Although Newtronics supplies their resonator tip rods with a "split pea" type of marker (which you move to mark your favorite frequency) this is good for one setting only. What if you want to mark the whole band, every 100 kHz, or for two cars (which never seems to fall at the same setting of the resonators)?

My solution was simple . . . after finding the point of resonance, I filed a small notch into the tip rod, with the edge of a file. A slight notch on one side of the rod is easily spotted, and in no way hampers operation of the resonator.

My 40 meter resonator, which has notches for car No. 1, car No. 2, CW, mid-band, and phone portions, somewhat resembles Jesse James' gun handle, but I can move from car to car, or from phone to CW without worrying about swr, and know my signal is at its best.

A word of caution – keep a list in the glove compartment of which notches are for what frequency, lest you have to get out the trusty swr bridge and go over it again.

This system, while used on my "Hustlers," would work just as well on any of similar antennas.

. . .K4TWJ

INTEGRATED CIRCUIT TV SYNC GENERATOR

Claude Wiatrowski K9AAC/7
3401 N. Columbus Blvd.
Unit 7
Tucson AZ 85716

The prices of both digital and linear integrated circuits have fallen so quickly in the past few years that it now costs more to build certain electronic systems from discrete components than to buy the equivalent integrated circuit. This article describes just such a case: the use of digital integrated circuits in a synchronizing generator for an amateur television station. This is not the usual sync generator probably found in the majority of amateur television stations. It generates the same sort of synchronizing, blanking, and drive signals that commercial television stations generate. Equivalent sync generators using vacuum tubes are found in commercial stations to this day. They are notoriously unstable, difficult to adjust, consume upwards of 450 watts of power, and may fill one or two large relay racks. The integrated circuit version described in this article is extremely stable, has only five easily set independent adjustments, consumes a little over one watt of power, and will fit behind a standard rack panel. More remarkable is the fact that the total cost of the unit is under fifty dollars.

Now, if you are interested in contructing a sync generator, I will assume that you have

some experience in television systems. For those of you interested in the theory of the unit, I will also assume you have a familiarity with basic digital circuits and logic.

The blanking signal generated by this unit is identical to the signal all television stations, both amateur and commercial, use for this purpose. The sync signal generated, used by all commercial stations and very few amateur stations, may not be familiar to the amateur television operator so a short explanation is in order.

The Synchronizing Signal

Many simple camera designs that have been published in amateur journals rely on the blanking signal to synchronize the scanning oscillation in the receiving television. A more sophisticated approach is to add separate sync pulses on top of the blanking pulses while establishing a definite time relationship between the line and field frequencies, a truly interlaced system, as opposed to random interlace. Note, however, that in both systems the horizontal scanning oscillator of the receiving television will not be synchronized during the vertical sync pulse.

In order to achieve accurate interlace, it is imperative that the horizontal oscillator remain synchronized at all times. To accomplish this, the vertical sync pulse is serrated at twice the horizontal rate. The sync separator in a television receiver consists of a differentiator and an integrator. The output of the differentiator is a series of very short pulses corresponding to the edges of the synchronizing pulses. Since the widths of the pulses have no effect on the differentiator output, its output remains the same through the vertical sync interval due to the extra edges on the serrated vertical. It is this output that keeps the horizontal scanning oscillator synchronized at all times.

The integrator, on the other hand, responds to the widths of the pulses. The output of the integrator is roughly the average over an interval of time of the area of the pulse train. Indeed, then the output of the integrator increases as the pulses become wider and decreases as the pulses become narrower.

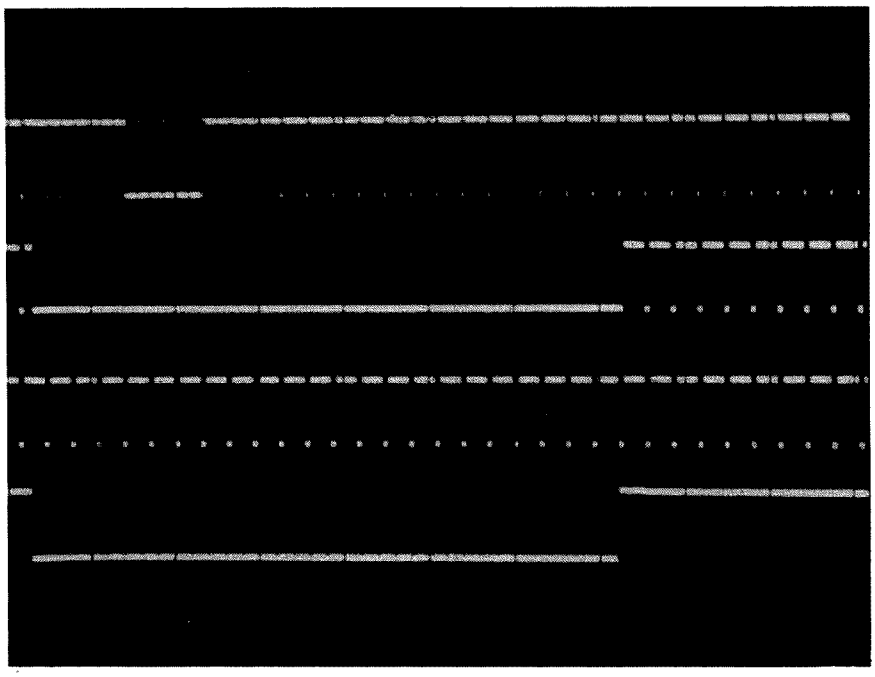


Fig. 1. Scope trace photo of sync and blanking signals and horizontal and vertical drive.

Since the vertical sync pulses are wide compared to the horizontal pulses, the output of the integrator corresponds to the vertical sync pulse interval. It is this output that synchronizes the vertical scanning oscillator.

Because every other field ends on a half line, the last horizontal sync pulse will vary

in position relative to the vertical pulse by 31.75 μs. This will cause the output of the integrator to be shifted by a small amount on alternate fields. This shift is enough to cause the lines on alternate fields to pair rather than be spaced equally. The group of pulses that remedy this situation are called equalizing pulses.

Six pulses, each of half the area and twice the repetition rate of the horizontal pulses, are placed before and after the vertical sync pulses. Being the same on every field, they serve to buffer the integrator output against shifts of the horizontal sync pulses which now occur farther away in time.

The complete sync, blanking, and drive signals are shown in **Fig. 1**. This has not been intended as a rigorous treatment of the television synchronizing system. For the interested reader, the subject is covered in many texts.

All gates are negative logic *nand* or positive logic *nor*. As this unit was designed with negative logic in mind, the analysis proceeds most easily from this viewpoint.

The flip-flops toggle on the negative-going edge of a trigger (T) pulse provided the set (S) and clear (C) terminals are left floating or are grounded. A signal of +3V on the set and 0V on the clear will cause the flip-flop to set on a negative-going trigger edge. (Set is interpreted as meaning terminal Q in the drawings will go to +3V and terminal $\overline{Q}$ will go the 0V.) An analogous situation exists for the clear input and the reset condition of the flip-flop. These flip-flops also have a dc clear which resets the flip-flop on a 3V pulse or level which overrides the inputs on all other terminals.

The Clock and Frequency Dividers

Basic components of any accurately interlaced scanning system are frequency dividers. One frequency divider divides the input frequency of 31.5 kHz by 525 to obtain a signal at the field rate of 60 Hz. Another unit divides by two to obtain 15.75 kHz, the line rate. In the sync generator described in this article, the dividers are actually electronic binary counters requiring no adjustments. The simplest of all these circuits will divide only by powers of two. An example is the 4:1 counter of Fig. 2 used to obtain a 31.5 kHz signal from a 126 kHz oscillator. It is necessary to apply feedback to count by numbers other than a power of two. The 15:1, 7:1, and 5:1 counters that make up the 525:1 divider in Fig. 2 are examples of this type of counter. Briefly stated, the output of the *nand* gate associated with each counter resets the entire counter to zero when the required count is reached.

The 7:1 counter has some minor variations. The last stage is reset by the action of the previous stage resetting. A capacitor is placed across the input of this counter.

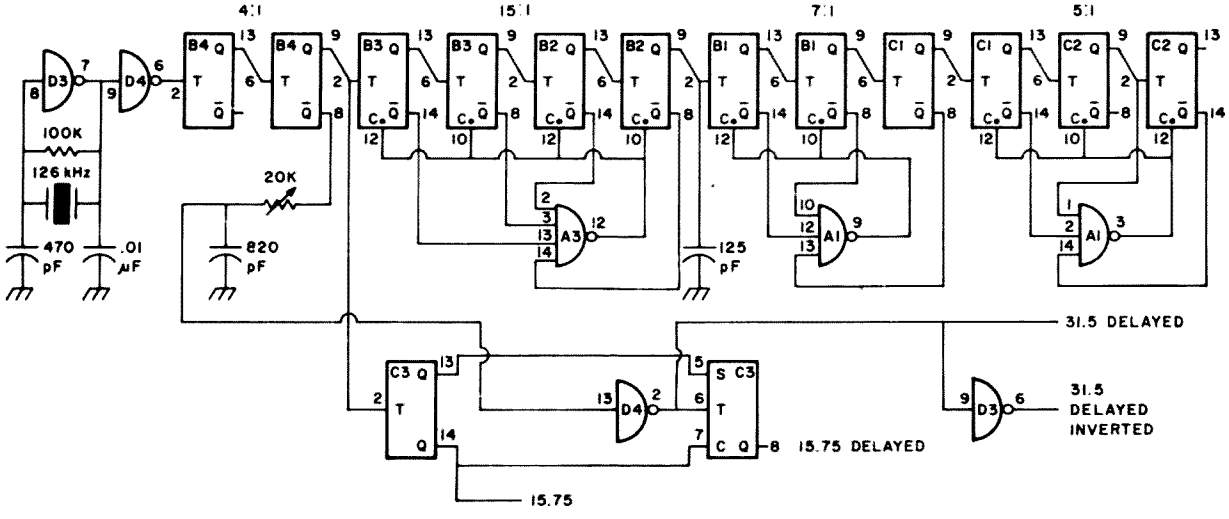
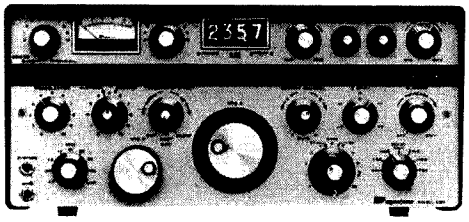


Fig. 2. Master oscillator frequency dividers.

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These two modifications are necessary to prevent extraneous pulses from resetting or triggering the counter stages. This is fast logic and the offending pulses are less than 1V in magnitude and 50 ns in length.

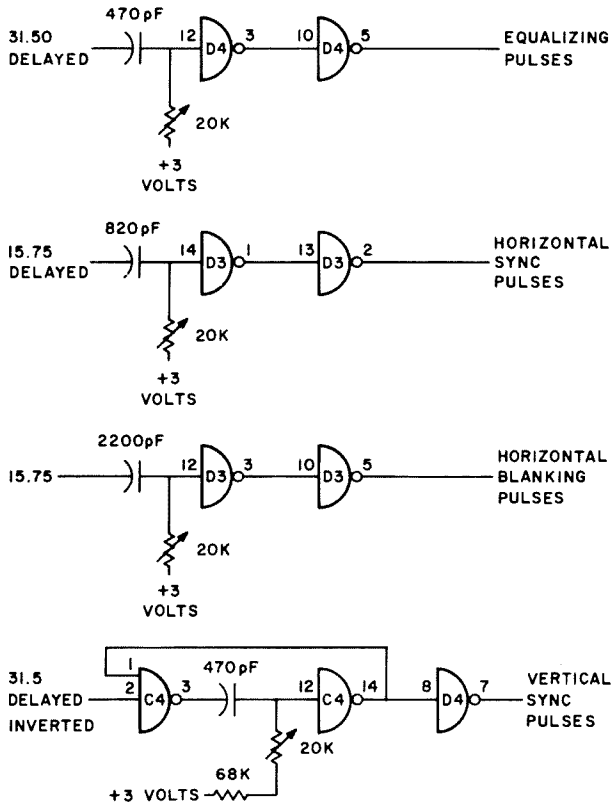


Fig. 3. Pulse generation.

There are two separate 2:1 counters. One counter is triggered by a signal delayed by an inverter and RC circuit connected to its input. The connections from the outputs of the nondelayed counter to the set and clear inputs of the delayed counter keep the two counters in phase. Without these connections it would be possible for the sync pulses to appear between rather than on top of the blanking pulses The delayed outputs are used to trigger all basic pulses except the horizontal blanking pulses. This delay which is adjusted to 1.27 μs accounts for the space between the leading edge of the blanking pulse and the leading edge of the sync pulse (sometimes called the front porch).

The delay is accomplished as follows. Assume that the input of inverter D4 is initially at 0V and its output is at 3V. If the input voltage to the potentiometer suddenly rises to 3V, the capacitor will only slowly

change to 3V. The rate of change is adjusted by the potentiometer so the input to the inverter rises to the point necessary to saturate the transistor in the inverter after 1.27 μs. Thus, 1.27 μs after the input transition takes place, the output transition will take place from 3V to 0V.

The master oscillator operates at 126 kHz. This frequency was chosen because crystals for this frequency are less expensive and more easily obtained than lower frequency crystals. The circuit is a Pierce oscillator constructed from a digital inverter. A second inverter is used to shape the output to trigger the 4:1 divider to 31:5 kHz. The 0.01 μF phase-shifting capacitor may have to be increased for a lower Q crystal. It is also possible for this circuit to oscillate at a harmonic of 126 kHz. The cure here also is to increase the value of the capacitor.

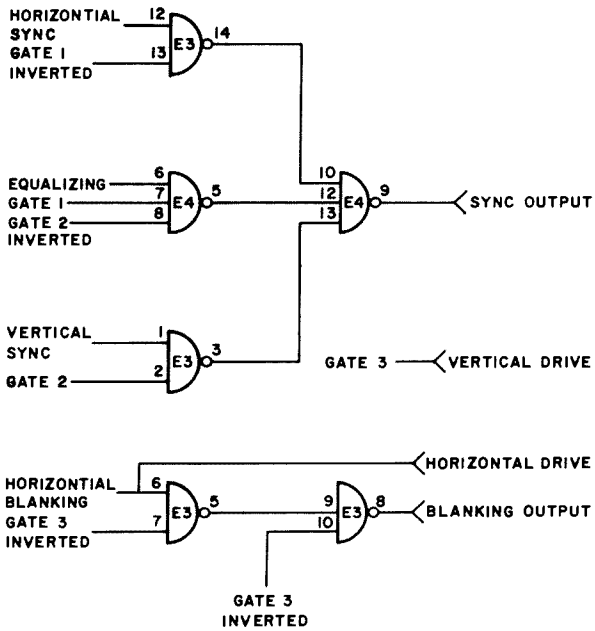


Fig. 5. Output gating.

Pulse Generation

Four monostable multivibrators are used to generate the following pulses: equalizing pulses, 2.54 μs; horizontal sync pulses, 5.08 μs; horizontal blanking pulses, 10.16 μs; and vertical sync pulses, 27.31 μs.

The 27.31 μs monostable is a standard design contructed from two gates. The other monostables are constructed from one inverter each. They are not true monostables in the sense that they do not have feedback.

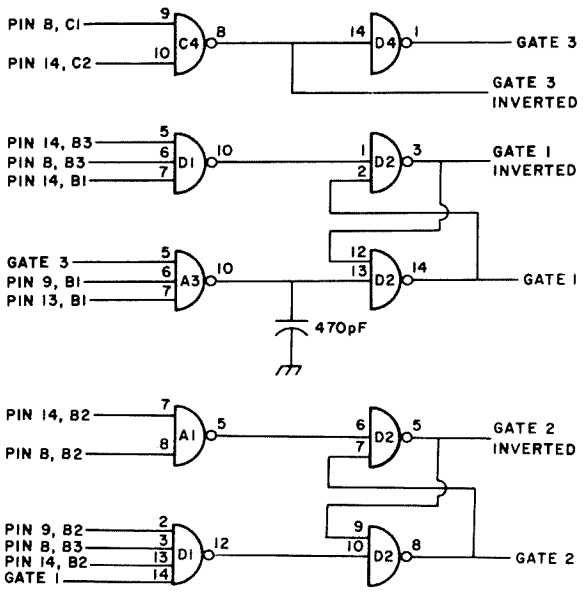


Fig. 4. Gate generation.

They will work in this application because the half period of the driving waveform is longer than the resquired pulse width. The circuitry is shown in Fig. 3. All outputs are inverted.

Generating the Gating Signals

The main counter has 525 unique states of each of its flip-flops. These states can be decoded to provide gating signals.

Gate 3 is the vertical blanking signal. It is generated directly as a combination of the states of two flip-flops of the counter. This gate is about 3 horizontal lines longer than the recommended width. This is virtually unnoticeable and the additional logic necessary to correct it hardly seems worth the additional complication and expense.

Gate 1 gates off the horizontal sync pulses and gates on the equalizing pulses. Gate 2 gates off the equalizing pulses and gates on the vertical sync pulses. Gates 1 and 2 are both produced by gating pulses from the main counter at the beginning and end of the gate times and using these pulses to set and clear flip-flops made of two cross connected *nand* gates. The circuitry is shown in Fig. 4.

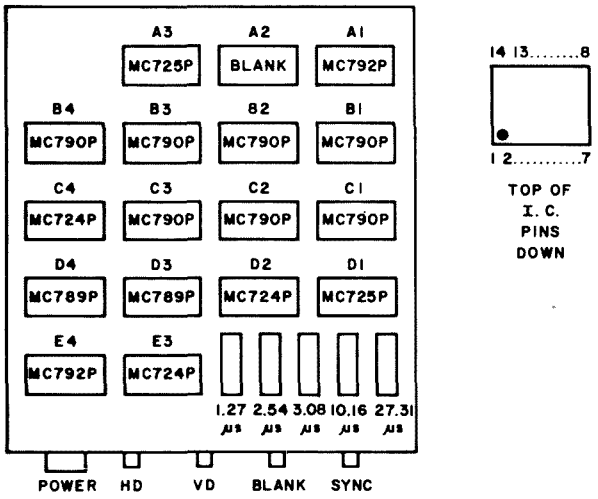
Output Gating

Gates 1, 2, and 3 are used to turn off and on the basic pulses at the required times.

Gate 3 (Fig. 5) gates off the horizontal blanking pulses during the vertical blanking interval and it itself is inserted as the vertical blanking signal.

Possible Changes

It is possible to generate "on" and "off" pulses and use these to set and clear a flip-flop to generate gate 3 analogous to the circuits for generating gates 1 and 2. In amateur service this additional circuitry hardly seems worth the additional cost and complication. If the unit is intended for commercial service, this modification will be necessary. Other modifications that would normally be required for commercial service would be separate width and position flip-flops and associated gating for the vertical and horizontal drive signals. Another "must"



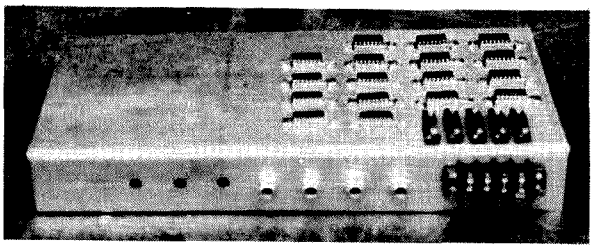


Fig. 6. The completed sync generator.

is the inclusion of alternative methods of master frequency control, such as a method to lock the generator to the power line or some external source (such as network or remote site sync generator).

Construction

The unit is constructed on a 6 x 12 in. chassis of which only 6 x 7 in. is used for the sync generator (Fig. 6). The primary consideration to bear in mind is ease of wiring. Each integrated circuit has a possible fourteen or more connections to it and space for wiring can be rapidly depleted. This unit could ideally be constructed on a single printed circuit card, although the layout of such a large printed circuit is not a simple task.

On all integrated circuit sockets, pin 4 is ground and pin 11 is connected to +3.6V. The crystal socket was mounted on a bracket on the underside of the chassis. All discrete components were mounted on a directly on the IC sockets. I do not recommend this procedure as it makes an already crowded situation worse. A possible improvement would be to mount all discrete components on a piece of Vector board mounted on the underside of the chassis.

The multiturn potentiometers are a convenience but satisfactory operation should be possible with ordinary carbon potentiometers. Four phone sockets are used for sync, blanking, and vertical and horizontal drive connections.

The large empty space on the chassis, the extra output connectors, and the two spare terminals on the power block are for possible expansion to color. The IC socket is a 16-pin type that works as well for these 14-pin packages.

Adjustment Procedure

Assuming that you prefer to wire and test the generator in sections, the first section to be wired should be the clock and frequency dividers. Observe the input and output of the 15:1 divider on a dual-trace oscilloscope. There should be 15 input pulses for every output pulse. If you do not have dual-trace facilities, you can mix the two signals in a spare gate. Although the output does not look the same as with a dual-trace scope, the number of pulses that should occur *during the output pulse* for each counter can be determined from Fig. 7, which shows scope trace photos of the gating and counting circuits. The other dividers may be checked in the same way.

See that the 15.75 kHz and delayed 15.75 kHz signals are in phase. They will be if you have not made a wiring error. Adjust

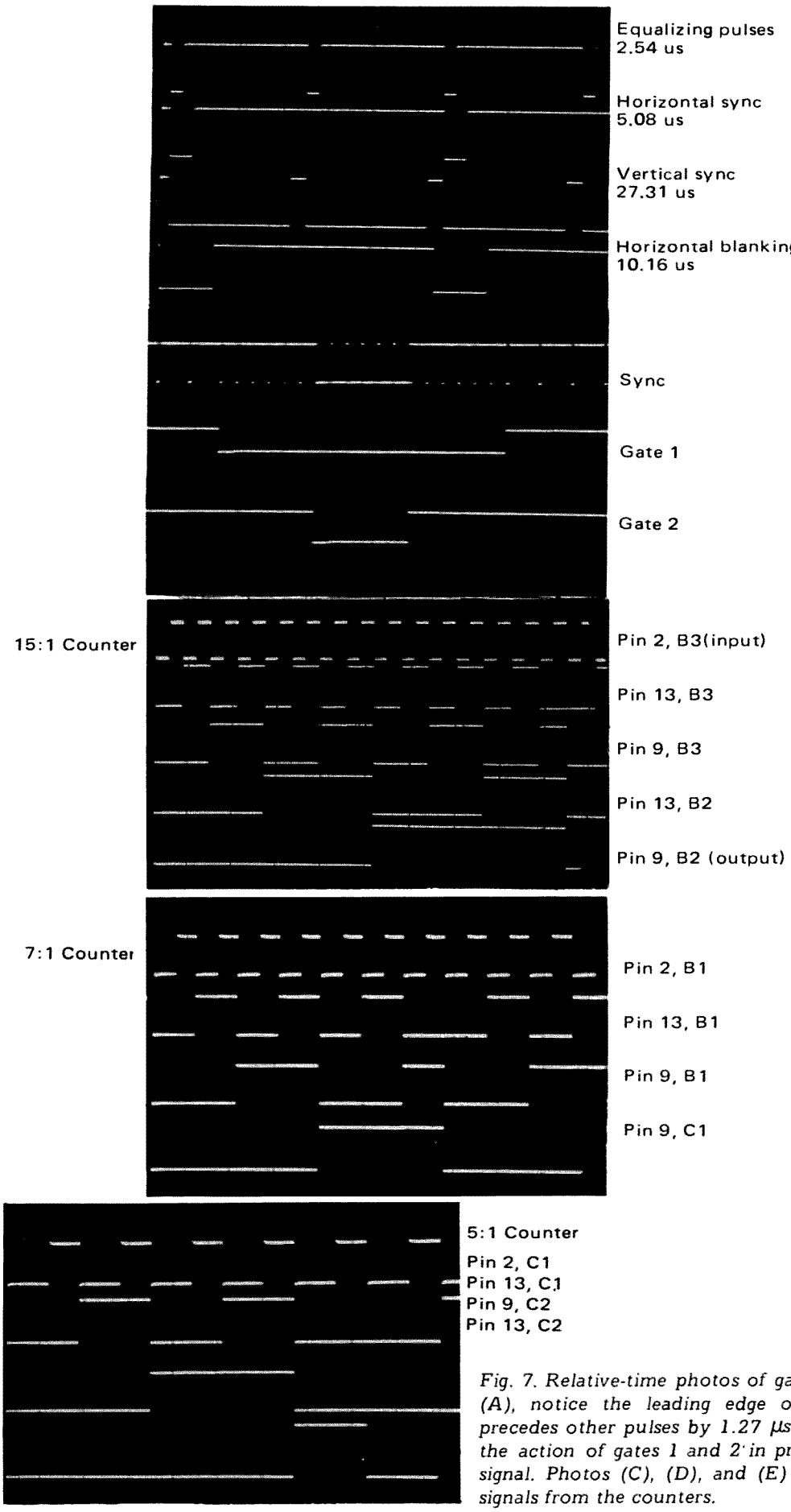
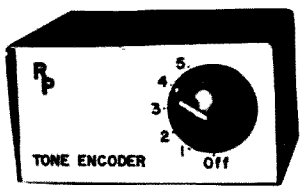


Fig. 7. Relative-time photos of gating functions. In (A), notice the leading edge of blanking pulse precedes other pulses by 1.27 μs. Photo (B) shows the action of gates 1 and 2 in producing the sync signal. Photos (C), (D), and (E) show the output signals from the counters.

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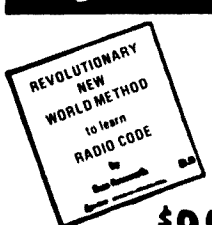


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the delay so that there is a 1.27 μs between the leading edges of the two signals. Again, without a dual-trace oscilloscope, mix the *inverted* nondelayed output with the normal delayed output. The pulse on the oscilloscope from the output of your mixing gate has a width equal to the delay time.

Since the outputs of this unit are the outputs of gates, they *will not* drive a low impedance load. All inputs to other equipment should be high impedance and the line should *not* be terminated with a resistor. This situation is ideal in my station as most equipment is of IC contruction and the output of the sync generator simply drives other gates. If you absolutely require low impedance signals, the outputs of the gates may be buffered with simple emitter followers.

Wire the monostables and their inverters next. Look at the output of the inverters and adjust the pulse widths to the correct values. Remember the pulses are negative going at the outputs of the inverters. Wire gate 3 first, then gate 1, and finally gate 2. The outputs of the three gates may be compared with the scope pictures in Fig. 7. Their widths should be: gate 1, 571.5 μs; gate 2, 190.5 μs; gate 3, 2857.5 μs. Lastly, wire the output gating and connect it all together. Sync, blanking, and drive should now appear at their respective output terminals. Check the appearance of the blanking and drive with an oscilloscope. The sync waveform may only be viewed reliably using an oscilloscope with delaying sweep. The delay has to be longer than two fields, as the horizontal sync pulses alternate their position every other field. Without these precautions you can not be certain that your scope trace is an accurate indication of the output waveform. Note, however, that *no* adjustments *have* to be made while looking at this waveform so if you trust your wiring and previous adjustment procedure, you can be confident of having a correct sync signal. If you still insist on seeing the sync waveform, it is possible to add a single flip-flop as a 2:1 counter connected to the output of this 2:1 divider to the external sync on your scope and you should be able, after some adjustment, to see the sync signal. . . . K9AAC/7 ■

An Introduction to a Science

Radio Astronomy and Amateur Radio

Osler H. Johns, Jr. W4ZBE
114 Rollins St.
Orlando, Fla. 32804

For a quarter of a million years, since man first stood erect on his hind legs, he has gazed with wonderment into the mysterious universe using only his eyes to receive the tiny bits of light energy arriving from the distant parts of space.

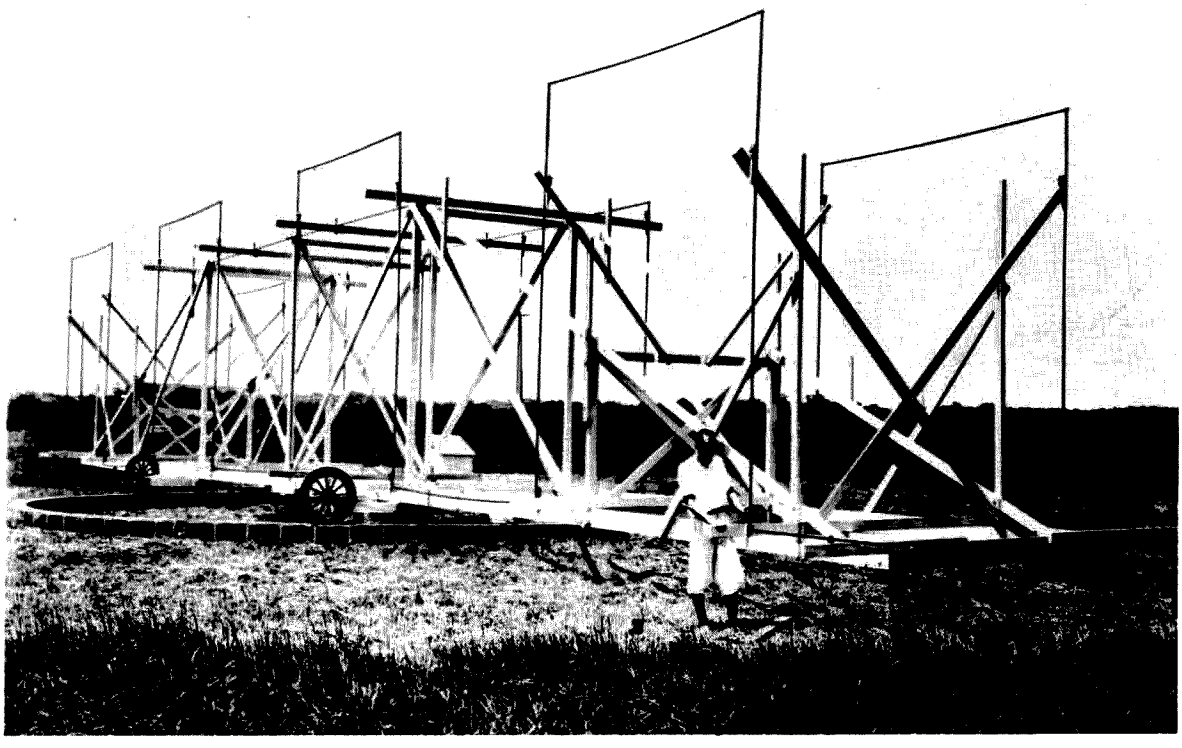
In the last one hundredth of one percent of time, in the history of mankind, man has used devices to aid his visual observation of the universe. The refracting telescope by Galileo was the first.

Only in the last one thousandth of one percent of mankind's lifespan has man been aware of energy other than light arriving at his planet. In fact, serious concentrated work in these fields has been taking place for less than 25 years.

Karl Jansky. In 1931 Bell Telephone Labs assigned a young engineer named Karl Jansky to investigate the problems involved with transoceanic radio interference. Lightning discharges, aurora, and the unknown way in which radio waves skipped off of the ionosphere combined to make for serious problems in long-range radio communications.

In order to monitor interference noise the young engineer built a large steerable antenna with, for the time, a very sensitive receiver. The antenna was 100 ft long and could be rotated 360 degrees to act as a direction finder. A frequency of 20.5 MHz was selected – a frequency well above that commonly used for broadcasting and communications in 1931.

Jansky's experiments detected a noise of a strange nature. The noise was of a continuous type rather than the erratic type associated with most types of radio interference originating within the atmo-



A historic photo of the late Karl G. Jansky of Bell Telephone Laboratories with the rotating antenna he used to discover radio waves coming from space. Mr. Jansky's investigations during the 1930s into the causes of strange noise in telephone equipment resulted in the discovery of radiation noise from the center of the Milky Way and gave the world a new science – radio astronomy. (Bell Labs.)

sphere. The noise was relatively strong and displayed the interesting property of starting 4 minutes earlier each day.

Karl Jansky himself correctly theorized that the noise must be originating from extraterrestrial sources in the galaxy.

During the next two years the Bell Labs engineer continued to study this extraterrestrial hiss. It was discovered by Jansky that the signal level was highest in the direction of the center of our own galaxy. He published his findings in professional journals during the years 1932 to 1935.

After 1935 the Bell Telephone Labs transferred Jansky to another research project not connected with radio noise from space.

Grote Reber (W9GFZ). Jansky did not follow up on radio astronomy after making his initial discoveries. His interests lay principally with radio communications and not with astronomy.

Grote Reber, a professional electrical engineer and avid amateur radio operator had read all of Karl Jansky's papers on extraterrestrial noise. As an amateur radio operator he had contacted other "hams" on all continents and in every state using equipment he built himself.

Reber, all on his own and in his own back yard, constructed a 31 ft parabolic dish antenna, and a receiver capable of receiving signals at 3300 MHz.

In 1937, this in itself was quite an amazing accomplishment. The frequency picked was twenty times higher than any frequency being used during the mid-1930s. It must be remembered that this was years before radar or microwave communications came into use. Dish antennas and microwave receivers were very rare indeed.

The equipment worked but no noise was received, so Reber decided to come down to a frequency of 910 MHz. Again no astronomical noise was received so Reber again decided to come down to a still lower frequency of 160 MHz.

By 1939 the diligent amateur had succeeded in receiving radio noise from several sources; however, astronomers of 1939–40 were reluctant to give complete support to

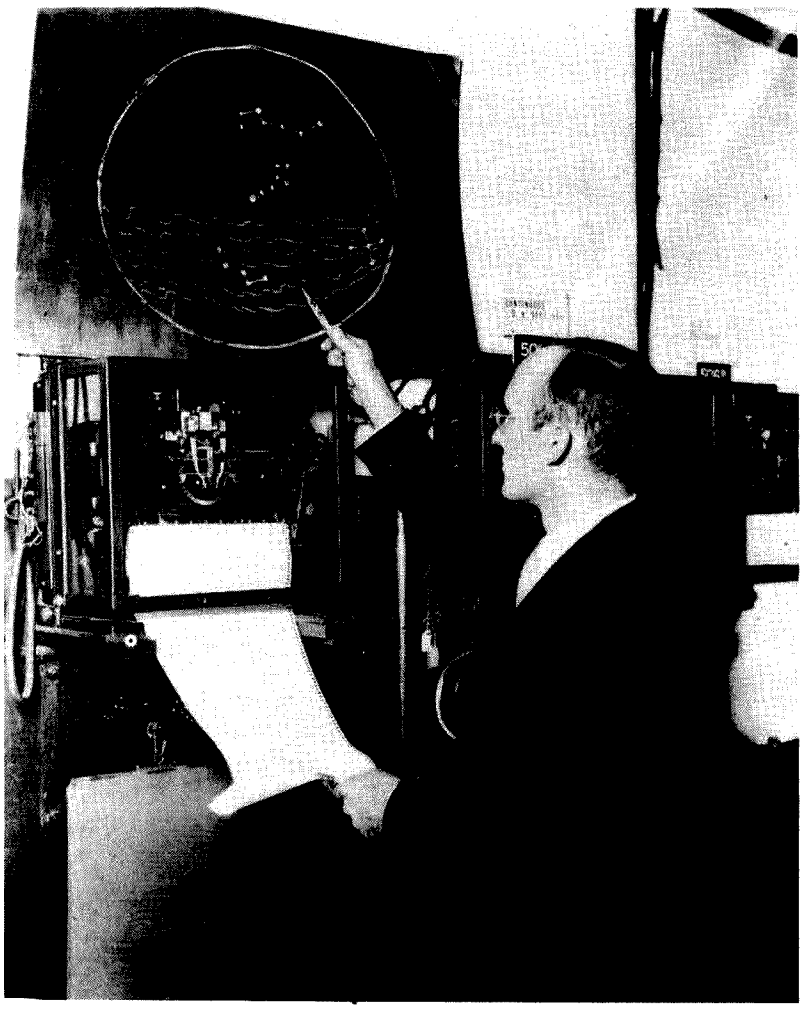
some of Reber's findings because radio wave radiation did not always correspond to optical astronomy findings.

In 1944 Reber published the first radio sky map; a map of excellent professional quality considering it was made by one enterprising amateur using all home built equipment.

An interesting method was used in making this radio sky map. Because of economy, Reber's telescope was not built to be steerable in azimuth but only in declination. For this reason Reber would position the antenna at one point of declination. The next night the antenna would be plunged a few more degrees. The next night the dish would be plunged several more degrees, and so on each night for the complete travel of the antenna in declination. Each night the sky would sweep past the antenna for each position of declination, thus after several nights the entire sky could be effectively mapped.

From the mid-1930s until after WWII there was only one radio astronomer – Grote Reber. Reber is still working as a scientist for the ESSA department of the U.S. Government; his major interest is with radio wave propagation.

World War II brought about many advances in the state of radio communications and radar. The most important advances were in highly sensitive high frequency and microwave receivers and in highly directional antennas. After the war, these advances in radio technology were put to use in the building of radio telescopes.



The late Karl Jansky of Bell Telephone Laboratories is shown pointing to the position on a chart where radio noises from space were first heard. While attempting to pinpoint the source of noise interfering with radiotelephone service, Jansky detected a peculiar hissing sound coming from the area of the Milky Way. Later this hissing was identified as radio signals generated by the natural processes in stars and galaxies. His work resulted in the new science of radio astronomy, in which the heavens are studied by listening to radio waves rather than looking through an optical telescope. (Bell Labs.)

One famous astronomer who decided to concentrate his efforts in the field of radio astronomy was an Englishman named Sir Bernard Lovell. Lovell is the director of the Jodrell Band Experimental Station. At Jodrell Band the first really large, fully

steerable radio telescope was assembled. The dish antenna was a monster of some 250 ft in diameter, but it could be aimed at almost any point in the sky with great precision! For some time the reflector was the largest radio telescope in the world.

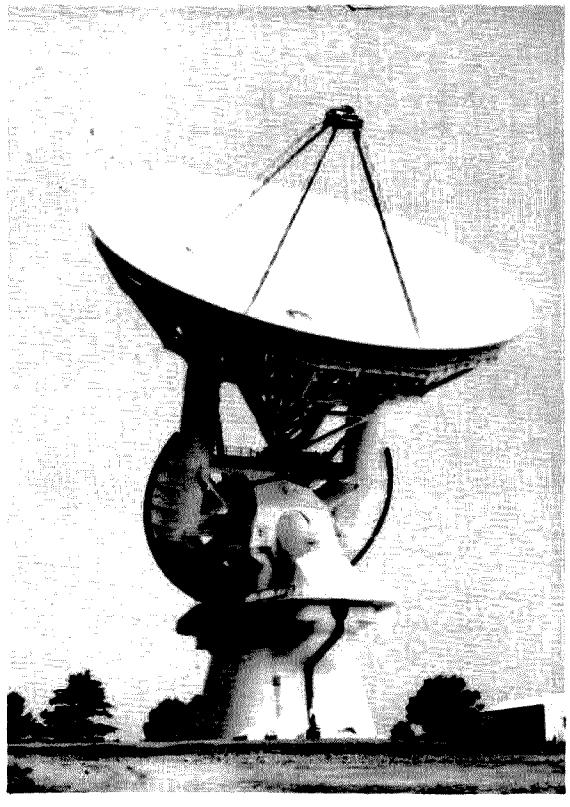
NRAO. By the early 1950s it became obvious that if serious work was to be accomplished using radio telescopes very large and very expensive instruments would have to be built. Such undertakings would require federal financial support because of the enormous cost of the equipment.

By the middle 1950s scientists interested in radio astronomical research had requested the National Science Foundation to construct a national radio astronomy observatory.

Green Bank, West Virginia, was chosen because of its remote location far from man-made electrical interference; the mountains surrounding the location acted as a shield; and a large expanse of available well-suited land became the choice for the national radio observatory.



Grote Reber (W9GFZ) the world's only radio astronomer from the late 1930s until after World War II. During the 1930s Reber constructed, on his own, a highly sensitive receiver operating in the microwave and UHF regions and utilizing a 31 ft dish antenna. He both constructed and designed his equipment and interpreted its findings. Without question, this man will be considered one of the giants in amateur radio circles in years to come. (National Radio Astronomy Observatory.)



The largest equatorially mounted telescope in the world (optical or radio) is the 140 ft dish operated by the NRAO at Green Bank, West Virginia. A single bearing supports the entire 2500-ton structure. This bearing is polished to a tolerance of 3 mils and floated in a 5-mil layer of oil. Such precision allows the great instrument to be pointed at any direction of the sky with extreme accuracy. The receiver is normally used at wavelengths shorter than 2 cm, or 15,000 MHz. The telescope took seven years to design and build and cost $14 million. (National Radio Astronomy Observatory.)

The complex of telescopes erected in the West Virginia mountains near Green Bank makes it the world's most versatile radio observatory.

The instruments include a 300 ft telescope which is the world's largest movable telescope; a 140 ft telescope with a very precise reflecting surface; and three 85 ft telescopes used in conjunction with each other. This array allows the three telescopes to in effect act as one telescope 5000 ft long. A portable 42 ft telescope rounds out the collection of instruments. The portable telescope allows the astronomer to extend the base line of the three permanent 85 ft telescopes, thus making a telescope which in effect is even longer than 5000 ft.

The engineers and scientists at Green Bank are already at work on an even more ambitious project. This new telescope would actually be an array of many separate antennas spread over a 26-mile area and feeding a single receiver. This would in effect make for an antenna that would be 26 miles in diameter. This 26-mile telescope has been aptly called the VLA (for "very large array").

University of Florida. The astronomy and physics department of the University of Florida at Gainsville, Florida, for many years has been doing research on radio waves arriving from noise sources within the solar system. The frequency used for listening is far below the frequencies usually employed in radio astronomy work. As a matter of fact the frequency is very close to that used by Karl Jansky in his original work.

Jansky, however, never received radio radiation from individual planets. If he did receive noise from planets he was not aware of it because of the poor resolution of his antenna system.

Much original knowledge about planetary astronomy has come from the University of Florida; of particular interest has been the planet Jupiter's relatively strong radiation.

Professors Alex G. Smith and Thomas D. Carr of the University of Florida have been particularly active in high frequency planetary radio astronomy.

Arecibo. No history of radio astronomy would be complete without including the giant telescope at Arecibo, Puerto Rico.

This huge telescope was the brainchild of Professor William E. Gorden of Cornell University.

The dimensions are truly staggering: 1000 ft in diameter; 500 ft deep; and a 500-ton feedhorn that is 200 ft long.

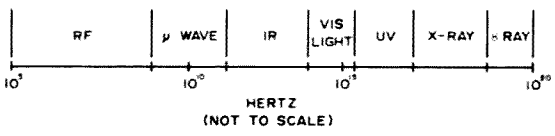


Fig. 1. Plot of electromagnetic spectrum shows energy distribution.

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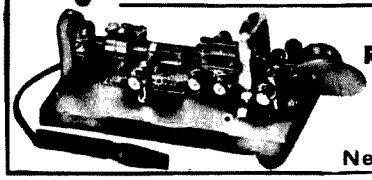
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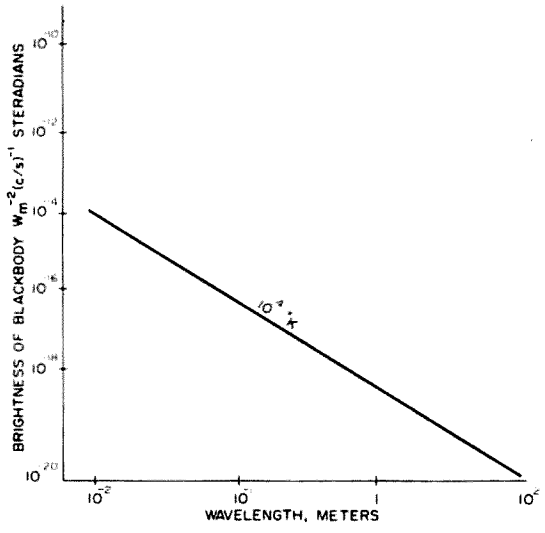


Fig. 2. Blackbody radiation, rf spectrum.

The large dish has been used for both active and passive radio astronomy (active radio astronomy being another name for radar astronomy).

As an active instrument it has allowed radar signals to be bounced off of the moon with great accuracy. Venus has also been a target for Arecibo's energy.

As a passive instrument it lays claim to being the world's largest telescope, optical or radio.

The $9 million project was built by Cornell University through funds made available by the Department of Defense's Advanced Research Projects Agency and the Air Force's Cambridge Research Labs.

Cornell University continued to operate the telescope after construction was completed.

Owens Valley Radio Observatory. The observatory which has located and identified more radio sources than any other observatory is the Owens Valley Radio Observatory of the California Institute of Technology at Big Pine, California.

Two 90 ft dish antennas make up the heart of the observatory. These are especially fine instruments built to close tolerances.

Financial support for the Caltech observatory was granted by the Office of Naval Research. The original construction cost amounted to $1,500,000. The telescopes were placed in operation in December 1958.

Australia. Much of the research in radio astronomy is presently going on in Australia.

B. Y. Mills is probably the most distinguished radio astronomer from the Island continent. He is the inventor of the "Mills Cross" which is an array of telescopes arranged for maximum gain. Mills is also responsible for most of the mapping of the sky in the southern hemisphere.

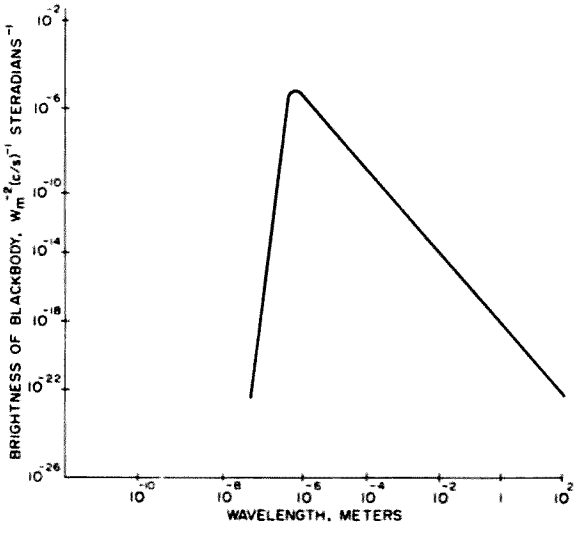


Fig. 3. Blackbody radiation curve for frequencies beyond rf portion of spectrum.

Radio Noise Sources

Radio waves make up a portion of what is known as the electromagnetic spectrum. The relative positions of the various forms of energy that make up the electromagnetic spectrum can be seen in Fig. 1.

The only difference between the various forms of energy is the wavelength and the energy they possess. In reality there is no sharp dividing line between the various forms but one form slowly takes on the identity of the next.

All objects above an absolute zero temperature radiate electromagnetic radiation into space with the energy being directly proportional to the frequency and inversely proportional to the wavelength. This is known as Planck's law and was formulated in 1901 by Albert Einstein.

A perfect radiator (and absorber) is called a blackbody source. A perfect black-

body is never found in nature, so the objects in space radiating electromagnetic energy fall somewhat short of the blackbody formula for brightness.

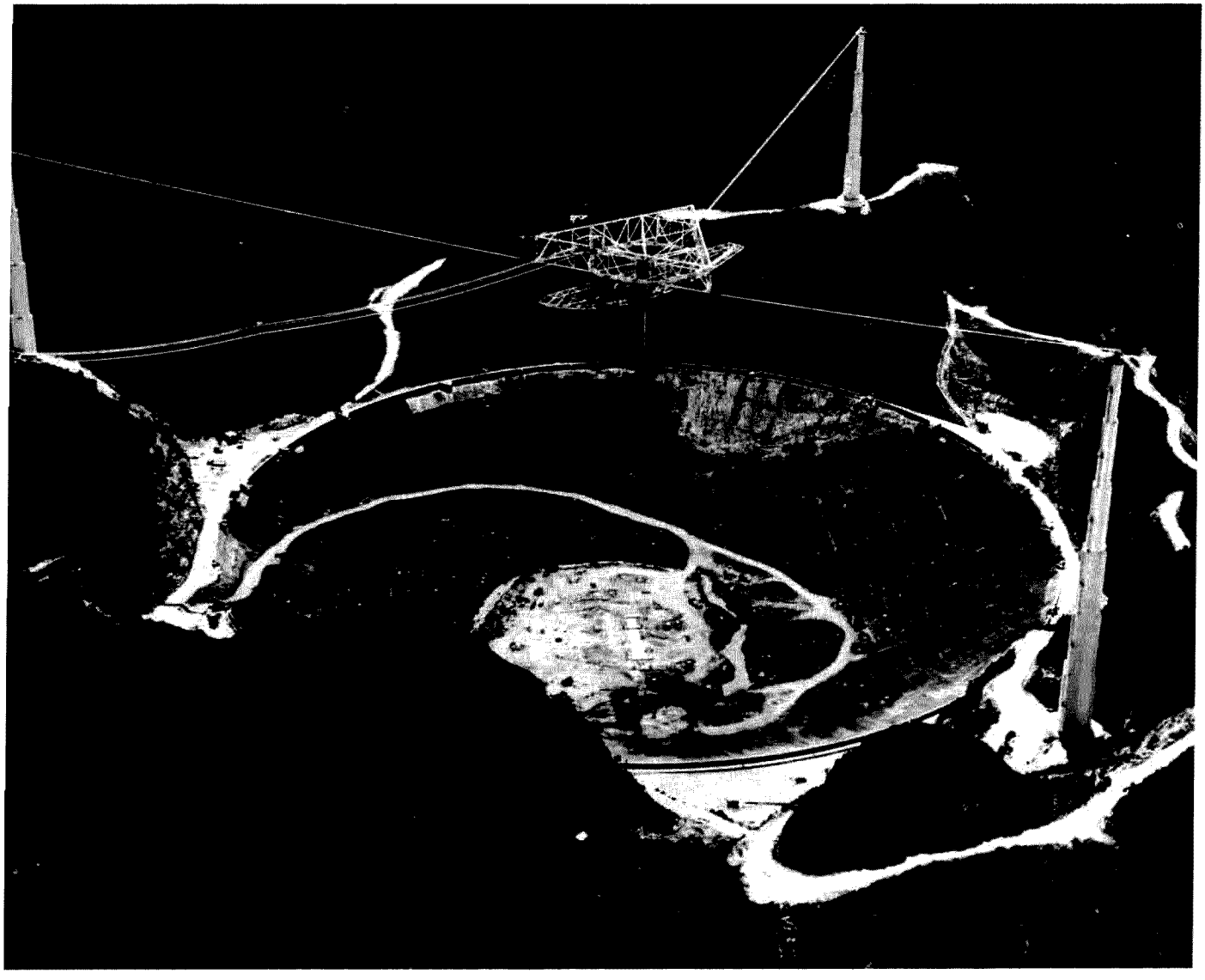
It should be obvious that brightness of a light wave is the same as signal level or intensity of a radio wave at a specific radio frequency.

When plotted on a logarithmic scale, the blackbody radiation looks something like the plots on Fig. 2. If the chart were extended past the radio frequency portion, the chart would look like that of Fig. 3.

Temperatures generated within the telescope itself often limit the ability to detect weak signals. The heat generated by transformers, vacuum tube filaments, sunlight heating the antenna, sunlight heating the transmission line, and heat from other electronic components must be taken into account.

The minimum temperature which the telescope will be able to detect can be found by a formula that involves such parameters as minimum detectable temperature, system noise temperature, rms system noise, antenna noise temperature, etc.

The above discussion has been concerned with what is known as thermal



The giant of all radio telescopes spans some 1000 ft in diameter and 500 ft from the feedhorn to the base. The feedhorn weighs 500 tons and measures 200 ft on each side. Arecibo has been used as both a radio telescope and a radar telescope. The 500-ton feedhorn is supported only by cables. Several contacts via EME with hams in the United States and around the world have been made on the ham bands with the big dish. (Cornell Univ., Arecibo Observatory, Puerto Rico.)

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blackbody radiation; however, other methods of electromagnetic wave generation are known:

Thermal emission from ionized gas: As an ionized gas the electrons are free from the nucleus and thus are in no specific energy level; however, the electrons are accelerated as they come in the vicinity of other charged particles. These accelerations of electrons cause electromagnetic radiations.

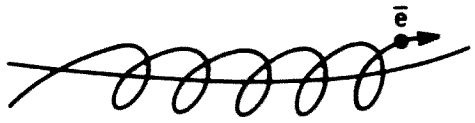


Fig. 4. Synchrotron emission: Free electrons in the arms of a galaxy moving at high speed in a gravity field.

Synchrotron radiation: The first emission which is nonthermal in nature is the synchrotron radiation (Fig. 4). In fact most nonthermal radiation in the universe is produced by this method.

Synchrotron radiation occurs whenever high velocity (high energy) electrons are accelerated to near the speed of light by a powerful magnetic field. The energy released by synchrotron mechanism is more intense than that released by thermal emission from ionized gas. As a consequence, this type of radiation is responsible for some of the most powerful sources yet detected.

Spectral lines: As electrons jump from lower to higher or from higher to lower energy levels within the atom, energy is either radiated or absorbed. This energy shows up as spectral lines throughout the electromagnetic spectrum.

Many of the spectral lines fall within the visual portion of the spectrum; however, some elements such as hydrogen are capable of producing spectral lines a considerable distance from visible light.

The most famous spectral line within the radio spectrum is the 1420.3 MHz hydrogen line. This is the spectral line produced by neutral hydrogen.

Evidence of this line is found throughout the universe; it occurs in open space between stars and between galaxies and at various temperature levels.

The above is only a brief survey of the mechanics of electromagnetic wave generation simplified from the book *Radio Astronomy* by John D. Kraus. Every serious student of the subject should consult Dr. Kraus' book for a more detailed discussion.

This portion of the text of this two-part article series has served to acquaint you with some of the individuals who pioneered radio astronomy as well as some of the technical disciplines involved in the field. Part II of the series will cover details about the radio spectrum of interest and describe basic radio telescope systems.

. . .W4ZBE■

WHAT'S PAST IS PROLOGUE

Delivered by
A. Prose Walker
Chief, Amateur and Citizens Division
Federal Communications Commission

There are more VIPs here tonight than at a National Convention . . . W3RE.

Introduction by Nelson M. Griggs W3UCT

Photos by Paul Segal



Photo of Mr. Walker courtesy of Auto-Call.

Gaithersburg, Md., Mar. 11 – A. Prose Walker, W4BW, the new Chief, Amateur and Citizens Radio Division of the FCC, proposed tonight that a "professional" amateur satellite be launched in synchronous orbit, possibly at the direction of the President of the United States. Walker was the featured speaker at the 16th annual dinner of the Washington Chapter, QCWA, meeting at the Washingtonian Country Club. He further suggested that the new bird fly in 1976 in celebration of our nation's second centennial.

The glittering audience of 376 paying guests included, in addition to QCWA chapter and national officials, the Board of Directors, the Executive Committee, the Secretary and General Manager and other staff members of the ARRL.

Walker was introduced by Harry Dannals W2TUK, newly elected League president, following the presentation of Golden Anniversary awards to four local chapter QCWA members: Charles Lewis, W3AXW; Elizabeth Zandonini, W3CDQ; Charles Stay, W4HE; and Edward Clammer, W3UN. Dannals also took the opportunity to present ARRL life memberships to those eligible applicants (including Walker) who happened to be present.

Prior to the main event speculation had been rife as to what the new chief might say that had not been already widely publicized. In this, the fifth in a series of talks given before amateur groups around the country, Walker chose the questionable future as his subject.

The text of Mr. Walker's speech follows:

The selection of a subject for tonight was somewhat difficult. There were three categories which seemed to fit the occasion. First I thought of talking about "The Good Old Days," but there are many of you here who know much more than I about that era . . . who can better recall the virtues of spark, the pungent smell of ozone, the blinking of the "Slop Jar" rectifiers, MHz-wide amateur bands without much QRM. So I gave up on that one.

The next possibility seemed to be "The Troublesome Present." That is a subject that I probably know something about. But I have *been* talking about such matters recently, at Las Vegas, Dallas and Miami, and most of you know what I think about many subjects which concern amateurs today. Furthermore, your speaker on this occasion last year, Mr. Burch, talked about one of the most troublesome aspects of current problems, the interpretation of section 97.39 of the Rules, commonly known as the "eye bank docket." But neither that subject nor a lot of others are yet resolved. Probably it seems to you that it will take some kind of a miracle to conclude most of the pending matters. Well, I think that miracle has happened, for we now have John Johnston with us in our division, as chief of the rules and legal branch, responsible for the resolution of pending matters.

So rather than try to further elucidate any of those, I decided to discuss the only subject left, "The Questionable Future."

According to an old Chinese proverb, *"It is extremely difficult to prophesy, especially with respect to the future."*

But there are signs and events, if properly interpreted, which may give us the jump on the natural evolution of things in amateur radio, or perhaps even guide them to a more proper conclusion. At least it might provide the opportunity for a head start. Whether we take advantage of it is up to us.

In respect to the "questionable future" turn your minds, if you will, to the potential of satellite communication for amateur radio, as has already been demonstrated commercially. I know that you thrilled a couple of weeks ago to the sight and sound of our President and the events surrounding his trip to China. Last summer in Geneva, the ITU established the Amateur Satellite Service . . . A.S.S. . . . one of our well known pundits who is often in error but never in doubt, says that if we sit on it we are sure to lose it . . . which is generally the history of spectrum allocations . . . as it should be.

Recently, I had the opportunity of hearing some ideas on a *"professional"* amateur satellite from Bill Eitel, W6UH, well known to all of you as one of the founders of EIMAC, and a leader in the communications industry. We didn't have much time to work out the details, but Bill's idea stimulated some additional thinking about the kind of satellite he perhaps had in mind. During the next few minutes, let's think about that satellite . . . what it might be . . . what it could do . . . the limitations that probably will be imposed on it . . . and the best way to use it, not only for amateurs but for the benefit of mankind.

I say mankind, because we shall think about something that could be beyond the normal concept of the 'public interest, convenience and necessity."

All of the five OSCARs launched to date have been short-lived, low-altitude, non-synchronous orbiting satellites. Those that did contain repeaters /transponders or whatever you wish to call them, were available to only a small number of amateurs throughout the world . . . amateurs who had unusual competence to track the satellites and top-notch equipment for receiving and transmitting. The people who were instrumental in building and launching them deserve a tremendous

amount of credit for their pioneering achievements. Without their work, it is most unlikely that the ITU would have established the Amateur Satellite Service . . . it wasn't easy even with their achievements . . . and we didn't get everything we wanted, but at least we got our foot one inch further in the door. Let's speculate briefly about the major technical characteristics of one version of this "professional" amateur satellite (with apologies to Bill Eitel if this isn't quite what he had in mind).

One of the major objectives is that it be available over a long period of time: Not just a month or 6 weeks, but a period of several years.

Predicted life of satellites today is in the order of five years. Whether we could obtain that is debatable perhaps, but it should be operable for at least a couple of years. This requirement is synonymous with a solar cell power supply, backed up by batteries.

Secondly, for the satellite to be generally available, its orbit must be such that complicated orbit prediction is not required nor complex tracking equipment necessary. Third, and this is almost a part of Point 2, availability to all amateurs of the world at one time or another, points to a near-geostationary satellite; one which slowly drifts around the world remaining available for periods of weeks or even months to amateurs in any particular hemisphere. This is the kind of satellite I would like to discuss . . . not a toy, but a "professional" amateur communication satellite, the limitations of which are only those imposed by cost considerations and the decision to put it into orbit.

Perhaps you are skeptical at this point. Instead of thinking about it in terms of resources, turn your thoughts around 180°. For centuries it has been true that the availability of the resource produced the decision to accomplish the objective. Within the past decade that has changed, and now it is *the decision to accomplish the task which brings about the resource* necessary for the job. Throughout the relatively short period of our engagement in space exploration, the decision was first made to do the job . . . then we set about providing the resource which resulted in the technology and hardware to probe the outer limits of the earth's atmosphere and beyond. This list of man's accomplishments in space is long; Explorer, Vanguard, Topside Sounders, Earth Resources Satellites, Orbiting Astronomical Observatory, Solar Observatory, Geodetic Observatory, Weather Satellites, not overlooking the series of manned flights starting with Mercury, Gemini, Apollo, and now Skylab and Shuttle.

Without denying the "fall-out" benefits from this gigantic effort, none of these endeavors have really been for the direct benefit of the common man. This may well be the shining opportunity to bring the benefits of satellite technology down to at least a segment of the population of the world through a "professional" amateur satellite. If the decision to put this kind of satellite in orbit were made by the Director of the OTP or the President of the United States, how many of you doubt that it would go up? Why not have it ready for the Bicentennial celebration of our country in 1976? I hope and believe that this will come about, somehow, somewhere, in some way. I know that Bill Eitel is thinking seriously about the prospects. The technology is here . . . are the amateurs ready?

What kind of satellite is this? It must be reasonably small and lightweight, but this depends on economics. It must have enough rf power output and bandwidth to permit its simultaneous use by a number of amateurs. Without going "overboard" and just for discussion, let's assume that it has 20 watts output. The operating frequencies probably should be as high as possible without ruling out general participation by amateurs. Let's choose a satellite with an up-link frequency in the 435–438 MHz band and the down-link in the 144–145 MHz band. The choice of these frequencies is probably rather good because on 435–438 MHz, remember, the ITU has told us that we must have the capability of eliminating potential interference to other shared services in that band. Obviously, it is easier to prevent interference from the ground than on a satellite. On the ground we can realize substantial antenna gain at that frequency. This *could* be done on the satellite but there are other aspects to consider. As an aside, one of the currently planned satellite experiments in conjunction with ATS-G will be using a 30 ft dish in space, having a gain of 18 DBI (Syncart).

To the uninitiated, some of the terms used in space work are confusing. We don't speak of field strength in microvolts per meter, but of power flux density, DBW/M^2. The origin for this and other terms came from the field of micro-wave communication where they speak of signal levels in terms of quantities of energy (flux) per unit area. The term DBW/M^2 simply means a number of decibels above or below 1 watt of energy or power (flux) per unit area of 1 square meter, and is spoken of as power flux density. In order to relate pfd to something all hams are familiar with, keep in mind that 1μV/M of field strength is about equivalent to −147 DBW/M^2. So this gives us an understandable relationship between power flux density in DBW/M^2 and electric potential between two points in space, measured in μV/M. The rest of our discussion is mainly simple arithmetic concerning what we can do with our satellite.

Suppose that amateur "A" wants to have a QSO with amateur "B." The former has a 100 watt transmitter with an emission bandwidth of about 20 kHz, and a dish or a phased array having a gain of 15 dB. Therefore, his effective radiated power relative to an isotropic antenna (E.I.R.P.) is +35 dB or about 3 KW. At 435 MHz the attenuation of the signal (commonly called path loss) from amateur "A" to the satellite, a distance of about 22,000 miles, is 156 dB, a negative quantity. So the +35 dB of power has shrunk to a −121 DBW/M^2 by the time the signal gets to the satellite. If we assume the satellite receiving antenna gain is +15 dB, then the signal at the satellite receiver input will be about −106 DBW, about 40 dB above our reference, −147 DBW/M^2, or roughly 100 μVM (we'll leave off the M^2 for it is assumed). So now we have the signal into the satellite receiver.

Let's assume that the satellite receiver we have in mind has a bandwidth of 200 kHz (which will accommodate about 10 FM signals simultaneously) and has a noise figure in the order of 10 dB, which is about what a real good TV receiver has. Therefore the total receiver noise power in the 200 kHz bandwidth will be about −141 DBW, and amateur "A's" signal is about 35 dB above the noise at the input of the receiver.

If you want 10 or more simultaneous QSO's and we have only 20 watts output from the satellite transmitter, then any one signal should "appropriate" only 1/n times the available power output, n being the number of QSO's. Skipping a little arithmetic related to the satellite characteristics we find that Mr. A's signal of −106 DBW has now become 0 DBW or 1 watt, taking into account the overall gain of the satellite transmitter, transponder or repeater as you will. On the down-link frequency of 144 MHz, the signal path loss en route back to earth is nearly 147 dB. When we boost the 1 watt output by the satellite antenna gain of 10 dB, and then lose the 147 dB, we reach Mr. B's antenna at a signal level (remember we now call it power flux density, PFD) of −136 DBW. Add to this the receive antenna gain of say 10 dB, plus a receiver with a noise figure of less than 6 dB and the result is a signal-to-noise ratio of about 28 dB.

GREAT . . . only in practice it won't be quite that good because of inter-modulation among the 10 or 20 signals passing through the satellite, which will reduce the output sig-

nal-to-noise ratio to a value somewhat below that for one signal . . . say about 20 dB. This is the reason why the receiver noise figure should be as good as possible, in order not to appreciably add to the noise already present on the incoming signal. If we use FM, the output S/N will be equal to the input carrier-noise ratio plus the FM advantage. We now have a satellite about the equivalent in physical size to the original "Early Bird."

One of the greatest problems that amateurs will have to face and overcome (and this is *self-regulation*), is the necessary discipline to maximize use of the satellite. Our postulated satellite can handle about 20 QSO's simultaneously, depending on exact values of bandwidth and power output. But this capability will be realized only if all participants observe self discipline concerning their E.I.R.P. If some amateurs appropriate more than their fair share of the available power through the satellite, it will leave less for others trying to use the system. Another important aspect of discipline will be listening on the down-link frequency to make sure that the proposed channel is clear in both directions. If this discipline breaks down, the result will be not only *QRM in the ordinary sense*, but also *cross-modulation* among *signals of unequal power* in the satellite receiver and thus lower the S/N ratio for everyone using the satellite.

By now you probably have concluded that all is not as simple as picking up your telephone. Depending on economics, amateur satellites may be power-limited. Therefore we should maximime the watt-per-dollar product by choosing up-link and down-link frequencies so that we may obtain as much gain on the earth end of the circuit as possible. All the satellite does is take the up-link signal, boost it by the overall satellite gain, and retransmit it on the down-link frequency. Also these frequencies must be carefully chosen with due regard for electromagnetic compatability on board the satellite, which is a fancy way of saying that we must avoid things like the 3rd harmonic of the down-link transmitter jamming the up-link receiver. Without going into details, the choice of 10 simultaneous QSO's is probably a fairly good figure, even though you are probably thinking "that ain't much." But bandwidth is directly related to total noise power, and if we theorized on 100 QSO's instead of 10 everyone would have to raise his E.I.R.P. 10 dB or the quality of transmission would be reduced.

Probably this is as good a place as any to remark that we seem to always have with us the question of the best way to utilize bandwidth, whether we are concerned with phone and CW on the HF bands – or satellite communication. In the case of our satellite, if we consider the use of CW, it would be possible to hold simultaneously 200 QSO's on the basis of 1 kHz required bandwidth per signal. If you could accept a lower minimum bandwidth of say, 200 cycles per signal for CW (which is probably impracticable), we could accommodate 1000 QSO's . . . always keeping in mind the disciplines we mentioned earlier plus a few I haven't touched on. Probably the best and most acceptable solution, as in HF, is neither all phone or CW, but a reasonable mix of both. But in the satellite case, there has to be world-wide adherence to the disciplines built into the system, or the satellite will not function to greatest advantage.

Up to now we have covered the satellite itself, what it could do and the limitations that may be imposed. But to what purpose do we put it? If we are able to convince others that such a satellite is worth the investment, surely there must be some useful purpose. I would not suggest that we should never use it for some or all of the purposes that have been mentioned such as a *"Satellite DXCC"* a *"Satellite WAS,"* an *"All OSCAR BPL"* or perhaps even for just rag chewing. But I have a feeling that these things by themselves will not justify such a satellite. It seems to me that one of the greatest uses of such a satellite *can and probably should be for educational purposes* not only to train our own young people in the techniques of satellite communication, but also others around the world . . . using the satellite for the exchange of information, advice and actual experience in satellite communication. The so-called "new and developing" countries of the world have not yet reached an acceptance of amateur radio as a worthwhile utilization of the radio spectrum. Perhaps if they see a benefit such as this, it would impress them with the tremendous promise that amateur radio can have for them in the development of trained people in telecommunication. In the plenaries of the ITU, I can assure you, we need their support.

There is another purpose of such a satellite that should be thoroughly explored. Perhaps it is significant that *none* of the currently utilized or contemplated commercial satellite systems are specifically designed for use in the event of a natural disaster, epidemics, famines, floods, earthquakes, tidal waves and similar things which afflict mankind. The need for such a system of communication has already been recognized by the ITU. However, no existing space communication system makes provision for specific channels for emergency communication. Will the amateur satellite service be competent to meet the challenge in extending our charter of 97.1 (A)?

> *"Recognition and enhancement of the value of the amateur service to the public as a voluntary, non-commercial communication service, particularly with respect to providing emergency communications"*

Or are we "just little boys playing in our basements" as we have often been referred to in the assemblies of the ITU? If we *are* up to the challenge and have what it takes, we could create a lasting impression of competence and worthiness in the eyes of world leaders, not just in the plenaries of the ITU

Perhaps it is too large a bite to swallow in one piece, but if we don't seek a larger goal than we have before us at present, what is the future of amateur radio? Are we content to become fragmented among ourselves, arguing like spoiled children about who should occupy what portions of our HF bands, or even VHF, now that we have finally started to earnestly occupy them? Are we fundamentally just a bunch of hobbyists who would idly chatter incessantly over our transmitters which occupy precious spectrum space? How many of you have read recently the basis and purpose of amateur radio contained in Section. 97.1 of the Rules?

What is our responsibility to future generations who will inhabit "our bands" some day when you and I are "silent keys?" Are we leaving them a legacy for the future based on sound judgment and planning? The growth curve of amateur radio in the United States has been more or less static for a number of years. Not so in certain other countries! Novices have constituted about 8½% of our total; Technicians 19%; Conditionals 11½%; General Class 34% and Advanced and Extra Class 26%. Are we attracting a fair percentage of young people to amateur radio? Granted that competition is greater now than it was 50 years ago, but information and learning aids are also more available than they were when you learned the art of wireless communication.

We hear a lot about revolution today in our society. The only apparent impact on amateur radio that I can detect is the increase in illegal operation, the upsurge of foul language to be heard almost any night you turn on your receiver . . . (especially on 75 meter phone) and the apparent desire to lower the qualifications for an amateur license. This is not the kind of revolution we need in amateur radio. If we have the

imagination to confront and reshape it, we might expect that this revolutionary attitude could be of help to us rather than a hindrance, in planning for the future. But if it *is* to be a help, we must present a challenging view of what the young generation can accomplish, not just what they can get out of it in terms of enjoyment because that's not enough. Young people are keyed to a rapidly changing, complex society . . . almost impossible for an older generation to comprehend. Dr. Robert Hilliard explains it with the statement,

"At the rate at which knowledge is growing, by the time the child born today graduates from college, the amount of knowledge in the world will be four times as great. By the time that child is 50 years old, it will be 32 times as great, and 97% of everything known in the world will have been learned since the time he was born."

Today's youngster generally, is not thrilled by the same things that sent you and me into orbit 40 or 50 years ago. He takes for granted what still gives us goose-flesh in our hind-sight perspective of the development of telecommunication. The frontier of amateur radio is in the field of satellites. I fully appreciate the difficulties of trying to keep abreast of things here on earth. Nevertheless, I urge those who have the responsibility for plotting the future course of amateur radio to look far ahead, lest the immediate problems within and outside our ranks occupy too much of our energies to the long-term detriment of amateur radio.

Over the next few years, I hope the Commission can erect a few new road signs and perhaps replace some old ones, to assist in the development of amateur radio, and keep it going down the right road. Whatever we do, I know you will evaluate it judiciously in the context of our common goal.

In Shakespeare's play *"The Tempest,"* Antonio summed up what seems to me is our position today when he said,

". . . What's past is prologue; what to come, in yours and my discharge."

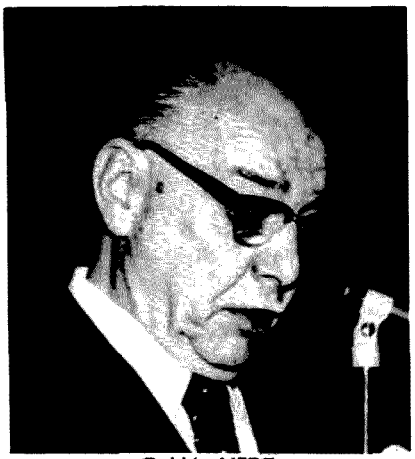
It is probably significant that the new FCC chief of ham radio was introduced by the newly elected president of the ARRL inasmuch as the powerful coterie of League wheels by no means came to Washington just to hear Walker speak. A highly placed league official, who declined to be quoted by name, told this reporter during the pre-dinner festivities that the group spent Thursday evening with OSCAR and AMSAT officials, and as a result drafted an agreement that would have lasting impact on ham radio in months and years to come. "Really tremendous," was all he would say, "without exaggeration." He refused to divulge any further details, but the impression was left that the ARRL, under the leadership of their new president, would take over OSCAR and AMSAT activities and merge them into the new "professional" satellite program.

Dannals, according to the dinner announcement, was also scheduled to speak, and many looked forward to a major League policy pronouncement. They were disappointed, however, when he confined his remarks to the distribution of some 7 or 8 life memberships and the introduction of Walker.

Another featured speaker was to have been the new president of the national QCWA, Barry Goldwater, W7UGA/K3UIG. He too was anticipated with eagerness, not only because of his U.S. Senate position (R. Ariz.), but also because of his considerable influence in amateur affairs. But Barry bowed out by telegram at the last minute.

Thus Walker had the stage almost to himself, except of course for the venerable Robbie, perennial toastmaster for these affairs. Mr. Harold H. Robinson, W3RE, is a perceptive and progressive thinker, and, despite his advancing years, is younger in mind and in heart than most of his younger contemporaries. Robbie and Mac Williams, K3AC, are wholly responsible for the success of these affairs over the past years.

The League has its dissident members here in the Washington area, however. One such, a ham of long standing and a loyal life member of the League, deplored the often untrue statements in the pages of QST concerning League activities. Also declining to be named, this Washington ham cited the minutes of the Directors' meeting and the editorial (p. 9, March) in QST concerning the outgoing president. "'. . . announced he would not be a candidate' indeed!" this ham said. "It is common knowledge that WØDX expected reelection as a matter of course, and was very upset when he was told two days before the election that he didn't have a chance. When Dannals was elected unanimously . . . " and here words failed him. When asked how he felt about the future under the new leadership, he replied, "U.S. amateur membership in the ARRL, its alleged representative society, is now only about 30% while in other countries ham membership in counterpart societies is between 80 and 90%. The outgoing president was a figurehead, a lousy director. This new man is a doer, full of pep, and capable. I think we are now in good shape. That's why I bought a life membership."



Robbie, W3RE.



200 years of hamming. Gus Gironda, W3JE, president of the Quarter Century Wireless Association, awards 50-year certificates to Charles Stay, W4HE, Edward Clammer, W3UN, Elizabeth Zandonini, W3CDQ, and Charles Lewis, W3AXW. All four recipients of the award have been active continuously throughout the half-century.

One highlight of the evening occurred when, just as Walker was getting warmed up, a shirt-sleeved attendant approached the lectern with a note and asked Walker to announce it to the audience. Walker took the note and read, "Cadillac sedan – several years old – 151713 – what about it?" The attendant announced, for all to hear, "The motor's running." Walker said, "Honey, that's your car." and Mrs. Walker left the room to remedy the situation.

Earlier, Walker had told the following story: "The other day I was discussing ham radio with a good Catholic priest neighbor of mine, name of Father O'Malley, and in the discussion I mentioned the name of Bob Booth (W3PS, ARRL General Counsel), and he wanted to know who Bob Booth was, and I said, 'Why, do you know him?' and he said, 'No, but his name comes up frequently while I hear confesssions.' " When asked later what Walker had meant, Booth, red-faced, replied, "I don't know, but I'm damned sure it wasn t complimentary."

All in the spirit of good, clean fun.

... W3UCT

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1829 Cornelia Street
Brooklyn NY 11227

The basics of how noise in various forms limits the performance of receiving antennas and systems is explored. The subject of ultra-miniature antennas is also covered.

NOISE AND RECEIVING ANTENNAS

One of the topics that the newcomer (and some oldtimers) find confusing is the relationship of noise in its various forms to the performance of receiving systems. Or, thought of in a different way, the subject of how sensitive a receiving system should be and what the ultimate degree of usable sensitivity is for a receiving system. This article discusses these topics in a general and nonmathematical manner. The mathematics of receiving systems with terms such as signal-to-noise ratios, noise factors, dBm sensitivity levels, etc. is not extremely complicated once one has developed the necessary conceptual background. However, for many amateur purposes, the mathematics of receiving systems need not be indulged in simply to experiment with the improvement of a receiving system. The main requirement to perform meaningful experimentation that is directed in a useful direction is simply to understand the interrelationship of the various elements in a receiving system and how changes in the characteristics of one element affects the overall receiving system.

Basic Reception Criteria

For the purpose of understanding a transmitted signal, the signal as it appears at the output of a receiver must be a certain level above the background noise. This criterion is true for CW and voice reception where an operator is the final "processing" device in the receiving system. Such a criterion may not be true for the transmission of signals which are completely electronically processed. The amount by which the intelligence signal must be above the background noise for an operator to be able to understand the intelligence depends upon several factors. For a highly experienced CW operator, a CW signal may only have to be a few decibels above the noise level to allow solid copy. For "voice," some words may be heard when the signal is only a few decibels above the noise level, but complete understanding may require the signal to be 10–20 dB above the noise level.

These considerations are further complicated by the fact that if the receiving operator has some foreknowledge of what is being transmitted, he will automatically start to fill in missing portions of a transmission.

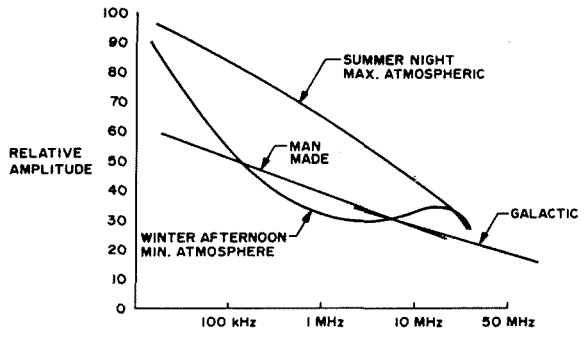


Fig. 1. The main sources of noise that influence reception. The exact amplitudes depend upon location. The relative amplitudes shown are those typical of the Middle Atlantic Coast.

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This sort of situation occurs quite often – for instance, when a contact has been established and the usual "RST, QTH, and name" information is sent. Many QSOs fall apart after such information is sent because the receiving operator no longer knows what to expect (this assumes that the code speed proficiency of the receiving operator is always adequate.) So, there is a basic human characteristic involved in any type of CW or voice reception and the only overall definitive statement that can be made is that the human operator for aural reception requires the received signal to be some level above the noise level to extract intelligence from it.

Noise in a Receiving System

Starting back at the transmitter, and assuming the noise output of the transmitter is insignificant, the signal radiated in the immediate area of the transmitter is many times stronger than the electrical noise level. As the signal is propagated, its intensity decreases. At the reception point, the signal level will have some level as compared to the noise level at the receiving site. The noise level at the receiving site can be a combination of many things – atmospheric, man-made, and cosmic noise. Some of these noises are shown in Fig. 1. along with their variation with frequency. As can be seen, atmospheric noise can vary with time of year as well as with frequency. It also varies considerably with location. The type of noise which predominates depends upon a particular location. Man-made noise is a particularly unknown factor in any location. The other noise sources lend themselves to prediction and calculation, and many charts, maps, etc. can be obtained relating to them. The very simple but still important consideration at this point, however, is that a desired signal (Fig. 2) arrives at a reception point with a definite level as compared to the noise at that point. Aside from the possibility of eliminating man-made noise, there is nothing that the receiving operator can do about this ratio of signal-to-noise level.

The next step in the receiving process (or perhaps the first step, depending upon how the process is defined) is the coupling provided by an antenna. The idea of an antenna as a coupling device is convenient for remembering that it couples both the signal and external noise to the rest of the receiving system. Unfortunately, this coup-

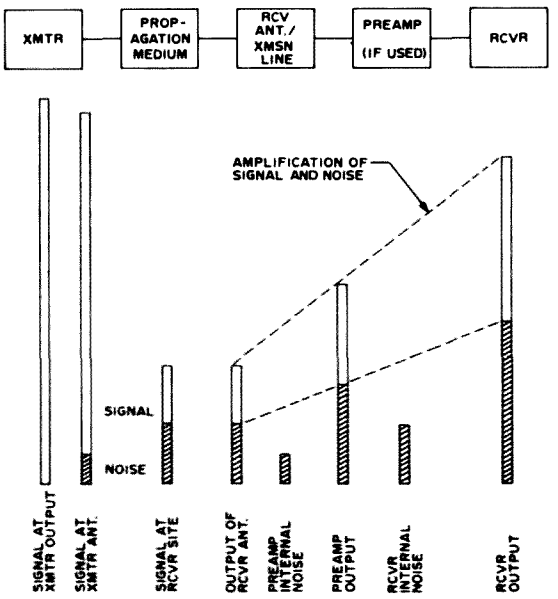


Fig. 2. The effect of noise and amplification at various steps in the transmitter output to receiver output chain.

ling process requires some kind of current flow and any kind of current flow is going to produce more noise. The noise produced is directly related to the losses in the system. These losses (attenuation) reduce the amplitude of the coupled signal and noise, but also introduce new noise. The fact that the amplitude of the signal and noise take on a new ratio is what makes the receiving system suffer – not the simple attenuation of the desired signal alone. For the moment, let us assume that the signal-to-noise amplitude ratio does not suffer during the antenna coupling process.

The next noise source encountered is that provided by a preamplifier, if such a device is used. As shown in Fig. 2, this noise source is shown to have a level less than that of the noise portion of the signal and other noise coupled into it. The amplifying device amplifies both the signal and the noise coupled into it. The output, then, is an amplified signal, amplified noise, and noise generated by the amplifying device. If the amplifying device is good, the signal-to-noise level ratio at its output will almost be the same as that at its input. But it can never be better.

If a signal-and-noise input is coupled directly to a receiver where the noise input is less than that of the receiver noise, the latter will "mask" part of the signal and a poorer signal-to-noise level ratio will occur at the receiver output than was coupled into it.

On the other hand, if the receiver-generated noise level is so low that it is always exceeded by the noise portion of the signal and noise input to it, a preamplifer has no value. The use of a preamplifer in such a case will make things sound louder, but it cannot improve the signal-to-noise level at the output of the receiver over what that ratio would have been if the input signal has been directly processed by the receiver. In fact, if a poor preamplifer is used which has an internal noise level greater than that of the receiver itself, the use of such a preamplifier will actually degrade receiver performance.

It should be noted that in all the signal transfer, processing, etc. which takes place, the objective is to *preserve* as much as possible of the original signal-to-noise level of the input until it can be amplified to the point where it is capable of being used to drive an audio transducer. If one remembers this simple idea, it will be obvious why losses have to be avoided as soon as possible in the receiving process, why preamplifiers should be placed as early as possible in the receiving process, and why a preamplifier, to be useful, has to be a very low-noise device.

The Receiving Antenna

From the foregoing, it would seem that the minimum requirement for a receiving antenna is that it just be large enough to pick up enough external noise to exceed the noise generated internally in the receiving system. Any signal could be received,then, since any signal to be useful anyway must have a level which exceeds the external noise level. This idea is basically correct. What, then, is the value of beams and other very directive antennas for *receiving* purposes?

A beam may have a transmitting gain of several decibels or more but it is still a passive device and, as such, cannot amplify any signal. It cannot produce a gain for receiving purposes in the sense that it amplifies a received signal. What a beam or other directive antenna can do is illustrated in Fig. 3. The omnidirectional antenna picks up both noise and signals from all directions. The directive antenna picks up signals from one direction but, more importantly, also only noise from one direction. The signal-to-noise ratio at the antenna terminals is enhanced in the sense that the total noise pickup of the antennas has been reduced.

It should be noted that the terms "gain" and "directivity" are related but have dif-

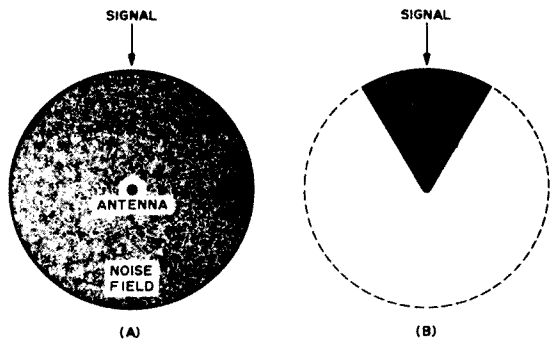


Fig. 3. The value of antenna directivity (B) for receiving purposes over an omnidirectional response (A) is that noise coming from directions other than that where a desired signal originates is discriminated against.

ferent definitions. Both can be expressed in terms of decibels and for some antennas, their value is the same. A large beam has gain for transmitting purposes and also exhibits usually an equal amount of directivity for receiving purposes. A very small antenna can still have directivity (a loop, for instance) but absolutely no gain.

If a very small antenna can exhibit the same directivity for receiving purposes as a large antenna, the question naturally arises as to why a small antenna should not be used instead for receiving purposes. Then, if one could only erect a modest type of transmitting antenna, it still would be possible to have a very effective receiving antenna. The situation becomes even more intriguing when one considers that, theoretically at least, a very small physical antenna provides the same amount of signal pickup as a large antenna. The amount of signal pickup of an antenna itself is not a direct function of its physical size. The advantage of a full-size antenna is that its terminal impedance is such that it matches to a transmission line or some sort of simple coupling circuit and, therefore, an efficient transfer of power from the antenna can take place.

The recent work which has been done on miniature or ultraminiature antennas has been directed toward finding an efficient method to transfer power from the physically small antenna. Transistor stages have been used as a coupling device instead of tuned circuits to match the highly reactive terminal impedance of an antenna very short in terms of wavelengths. Another approach has simply been to use an antenna length just long enough which would theoretically pick up enough atmospheric noise to be greater than the internal noise level in a receiving system. Such an antenna need only be a few inches long, for instance, at almost any frequency above the medium-wave band. The antenna is fed into a preamplifier stage with an extremely high input impedance so that the antenna is not "loaded down." Whatever approach is used, however, the factor of noise still enters into the picture because of the transistor stage used as part of the antenna (whether the stage is called a matching stage or a preamplifier). Active antennas do work, but the question of whether it is worthwhile to very carefully construct the active antenna using very low noise components, or simply to try to make a conventional antenna form electrically larger (perhaps by loading techniques) is a moot one. After all, there are very few situations where one cannot put up some sort of antenna that is more than a few inches long.

Noise Tests

Even with just *some* understanding of the role that noise plays in a receiving system, one can make some subjective analysis of what effect various components have upon a system. For instance, if the terminals of a receiver are resistor-load terminated, the antenna peaking control should produce a distinct increase in noise level at some point. With a terminated transmission line added to the receiver, the same peaking action should occur and the noise level output should be the same or slightly greater than before. If a preamplifier is used and its input terminated, the noise level should not increase if the receiver gain is adjusted to compensate for the gain of the preamplifier.

The best way, of course, to check the effectiveness of a preamplifier, or any similar device added ahead of a receiver which is supposed to improve its performance, is an actual reception test. If the preamplifer is switched in and out and a very weak signal can be heard with the preamplifer that could not be heard without it, you can be sure that the preamplifier has value. Note, however, that if a signal that can be received without the preamplifier simply sounds louder with the preamplifier being used, this does not signify anything about the preamplifier except that it produces some gain. Antennas can be checked against each other by being careful to keep the gains in a receiving system constant and noting which antenna, or what modifications to one antenna produce the best signal-to-noise level at the output of a receiver regardless of how "loud" a signal may sound. If the signal-to-noise ratio is the best possible, "loudness" can be provided at any point in the receiving system by means of additional gain.

W2EEY

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6021 S. 199th Street
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The Sewerpipe Antenna

The perhaps unfortunate name for this otherwise superb antenna derives from the fact that the chromium-plated brass tubing used as a matching section (normally obtained along with some funny looks from your friendly local plumbing supply house) was originally manufactured for quite another purpose.

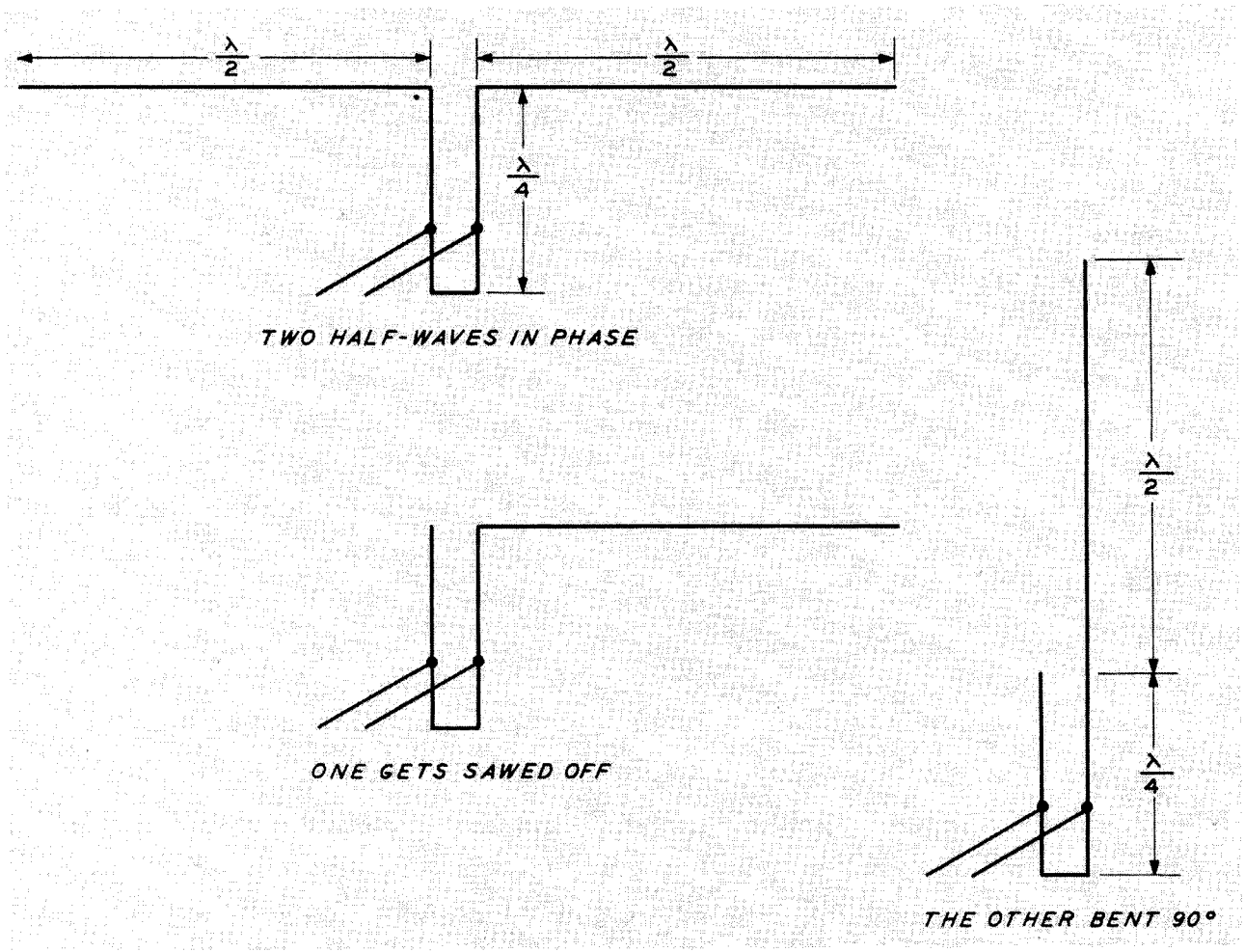


Fig. 1. Evolution of the J antenna.

It all starts with the J antenna, the evaluation of which is illustrated in Fig. 1. The J consists of a balanced quarter-wave matching stub feeding an unbalanced load as shown in Fig. 1 (C). But since balanced stubs work best with balanced loads as in Fig. 1 (A), some means of compensation must be provided to make the J workable.

Because of the unbalanced load on the matching section of a J antenna, the currents in the matching section are no longer equal and opposite, so the matching section radiates also. The resulting imbalance also couples rf currents to the supporting structure and the feedline, distorting the radiation pattern and making the antenna diffiuclt to match.

The step from the J to the *sewerpipe* arrangement is simple. Use an unbalanced coaxial matching section for the unbalanced half-wave load. Adjusting the antenna's impedance to 50Ω is easily accomplished as shown in Fig. 2.

Chrome-plated brass pipe of 1½ in. diameter is recommended for the matching section. If ordinary brass tubing is used, then a brass plug for the bottom can be turned to fit the tubing. Mechanical details are dependent upon the materials available, and will be left to the ingenuity of the builder. Dimensions are not critical, but things should fit together tightly. The inside depth of the matching section should be about 19 inches. Keep the plastic cap (Fig. 2 (A)) thin and use low-loss dielectric material, as this is a high voltage point. The internal feed assembly is physically similar to the gamma match used for unbalanced feed of a yagi antenna (omitting the series capacitor, of course). A clamp (Fig. 2 (B)) comples the connection from the off-center coax to the center conductor. The height of this clamp and the center-to-center spacing of the off-center member is varied to obtain a perfect match to 50Ω.

An interesting variation on the original sewerpipe antenna was developed by Prof. D. K. Reynolds (K7DBA) of the University of Washington. A different feed technique is employed, as illustrated in Fig. 3; the result is an ideal antenna for base station use. Antennas of this type are in use at Byrd

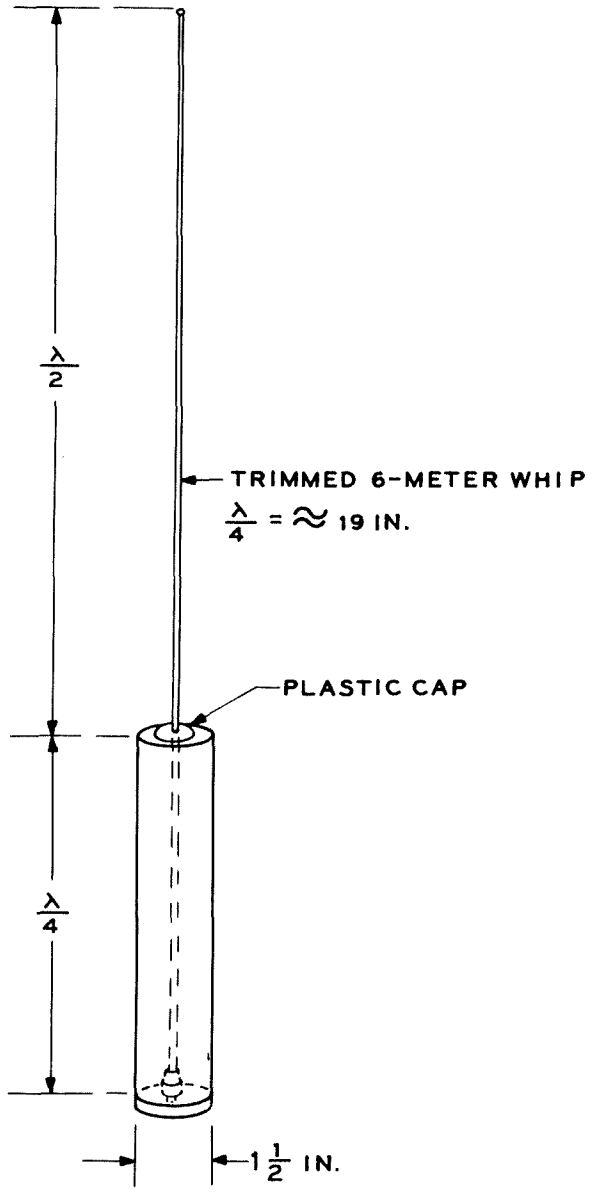
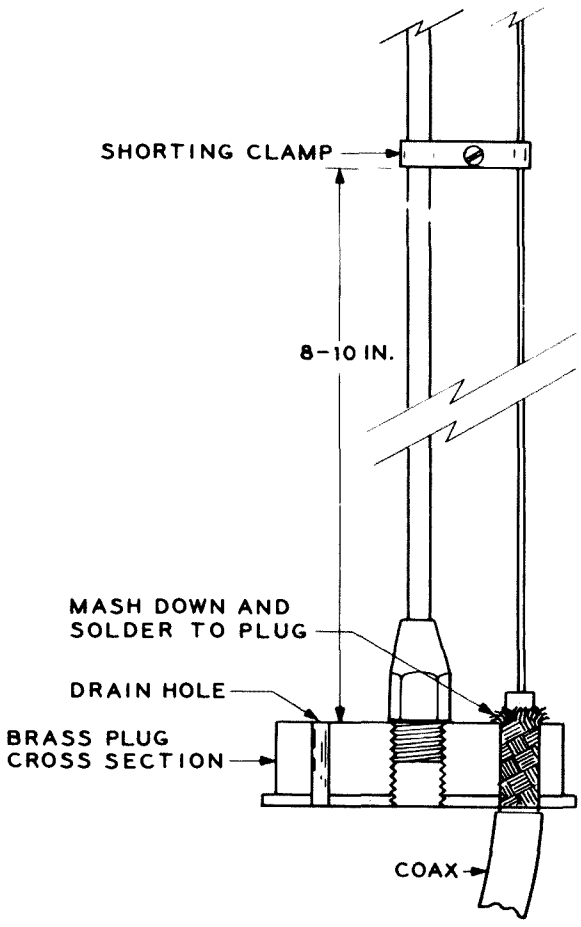


Fig. 2. The sewerpipe antenna.

VLF Substation, Longwire, Antarctica, home of the 21-mile dipole. There they use 146.76 MHz VHF/FM for both on-site and station-to-station communications.

Semigrid coax is used, and the 60Ω section is made by removing alternate half-inch sections of the dielectric inside the coax for about 16 inches. This raises the characteristic impedance from 50 to about 60Ω. The original version is more suitable for mobile use, however, because of its greater rigidity and mechanical strength.

Patterns taken at the University's antenna range show an almost perfect free-space dipole pattern. The measured gain over an isotropic antenna was 1.62 dB as compared



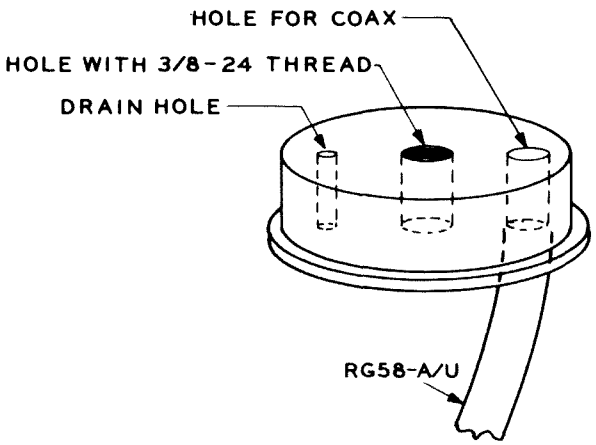


Fig. 3. Plug details.

with the theoretical value of 1.64 dB for an ideal dipole antenna. These antennas are unbelievably well decoupled from their supporting structure and are therefore a breeze to match. The only significant current is on the antenna itself.

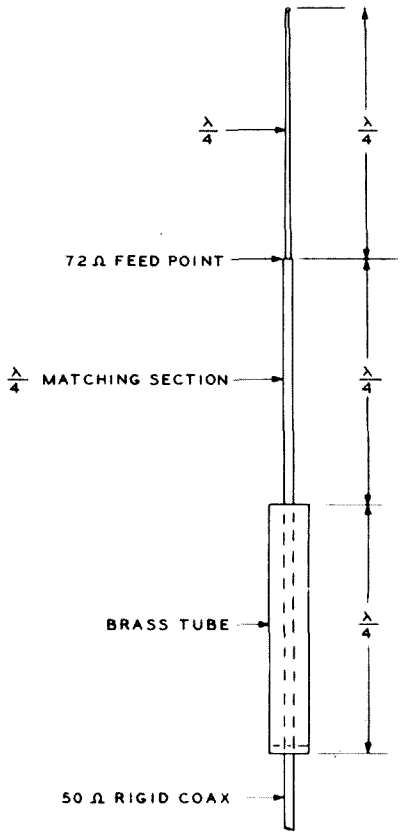


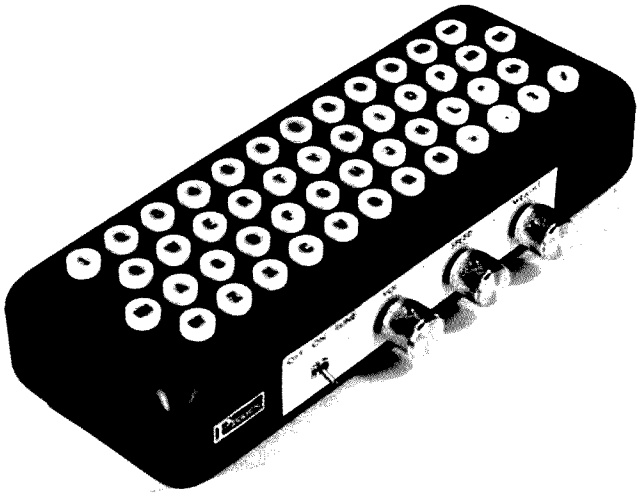
Fig. 4. Reynolds modified sewerpipe antenna.

Since no claim is made for extra gain, then where is the claimed improvement over other antennas? Basically, it is in the reduced angle of radiation. Practically speaking, most mobile antennas at two meters -- whether ¼ or 5/8 wavelength – have about the same gain toward the horizon; moreover, they all suffer to some extent *finite groundplane* effects, which act to lift the angle of maximum radiation intensity above the horizion. Thus the secret of the sewerpipe antenna's performance is its straight-out angle of radiation.

If you live in an area well covered by an accessible repeater and don't stray much, the quarter-wave whip may be just right for you. But if you need long-range capability for your mobile, give the sewerpipe a try. They have been widely used in the Pacific Northwest since 1961. The sewerpipe is ignored by all CB'ers (unlike a 5/8-wave whip), but seems to disturb the 75-meter mobile operators for some reason. Could be they think it's a new chrome-plated loading coil.

. . .W7PUG

Eric Falkof K1NUN/1
Assistant Editor
73 Magazine



PICKERING KEYBOARD KEYER

I had the Pickering Keyboard Keyer on my operating desk when an RTTY friend came in. "Don't you have to push FIGS to get numbers and punctuation and then LTRS to unshift?" he asked, forgetting that I didn't even own a printing unit. "No," I said, "this is for CW." "Then how do you send the dits and dahs?"

The Pickering Keyer is a fascinating unit that eliminates the mental gymnastics of translating letters into Morse code sounds. Lightly touching any of the glare-free buttons, even for an instant, will produce the Morse representation of the character. All letters, numbers, punctuation, and ham procedure signs ($\overline{AR}$, $\overline{BT}$, $\overline{SK}$ . . .) are self-completing once they have begun. For example, to send CQ, just touch C and then Q. Unfortunately, there is no memory for letters as there is for a dit or dah in conventional keyers. While the C is playing, the Q should be held down. This Keyer will complete the C, insert the correct between-letters space, and then it will send the Q. Longer words can be sent by touching the first letter and while it is being sent, hold the second. Once the second has begun, move your finger to the third and hold until it begins, and so on. Letter spacing is automatic; word spacing is up to the sender.

Obviously it is necessary to be familiar with a typewriter keyboard and a knowledge of touch typing is an asset. Knowledge of CW is still necessary to know when to move fingers from letter to letter. Since some letters are shorter than others, at higher speeds you have to be quick. The speed is adjustable by a front panel control from about twelve to seventy words per minute. Slower speeds are possible by increasing letter and word spacing. The dit length can be varied by the weight control. Some keyers are pre-adjusted for weight, but being able to adjust it is an advantage because copying ability can change with dit length, depending upon the rate at which CW is being sent. The letters will be sent in perfect form.

How easy is it to use? Very. First, plug the unit in and hook up a loudspeaker or headphones to the appropriate jacks on the rear panel. Turn the KB-1 on and press a few buttons to get the feel. Very little pressure is required to activate the IC logic systems to send letters. The keys have a barely perceptible movement and this makes rapid finger placement possible. The monitor produces a low pitch tone that is easy to hear above background noises without blotting them out. The volume level is an adjustment on the front panel. After practicing for several hours it becomes second nature to push a

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button and to hear the correct letter emerge from the monitor. Finger placement, even for a hunt-and-peck typist, becomes easy and rhythmic. Adjustment of the keyer speed to a comfortable rate coupled with a relaxed typing speed still allows the hunt-and-pecker to send perfect CW at speeds up to twenty words per minute. The Pickering is heavily weighted and it will not slide across the operating desk. You could even use it sitting upon your lap if you wished to use CW while mobile.

After becoming accustomed to hearing a complete letter in Morse when moving one finger a fraction of an inch, I tried the unit on the air. I told my contacts what kind of keyer I was using and comments included, "That's cheating" . . . "Sounds clean" . . . "Pretty good." Sending became effortless. The hand rhythm developed quickly and smoothly and the letters flowed out as I thought of them. It was a BPLer's dream.

The unit is ideal for code practice sessions, as we use it here at 73. It is easy to pick the unit up and carry it to classes, and even a beginner can send perfect code without even knowing it. This new dimension to learning also allows the sender to learn characters and spacing. The speed can be adjusted to a moderately high rate and long spaces can be inserted to give the impression of slower speed. This, incidentally, is the newly approved method of teaching CW: fast letters with long space. It allows the listener to adjust to the concept of shorter letter timing, just like he will get in actual copy off the air.

To hook it up to your rig requires looking at the transmitter's schematic. You must determine the voltage across the key, positive or negative, in order to connect the cable to the correct keyed output. This protection is necessary to protect the integrated circuits that make up the circuitry. If you make a mistake, no damage occurs.

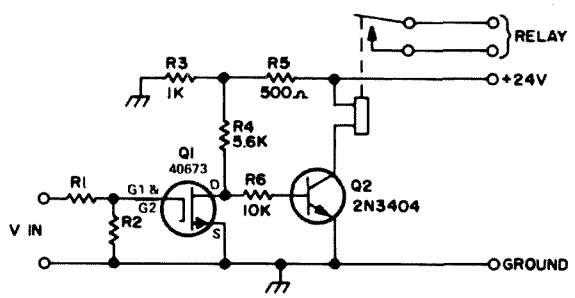
For the ham who takes Morse code seriously or for the professional code practice instructor, the Pickering KB-1 Keyboard Keyer is an indispensable tool for perfect CW. True perfection costs only $265 from the *Pickering Radio Company, P.O. Box 29, Portsmouth RI 02871.*

. . .K1NUN

John G. Oehlenschlager KØMOC
394-D Ricketts Road
Monterey CA 93940

SOLID STATE CARRIER OPERATED RELAY

There is a very versatile carrier operated relay which is adaptable to many supply voltages and can be used with either tube or solid state receivers. The circuit as shown operates on the standard 24V control voltage.

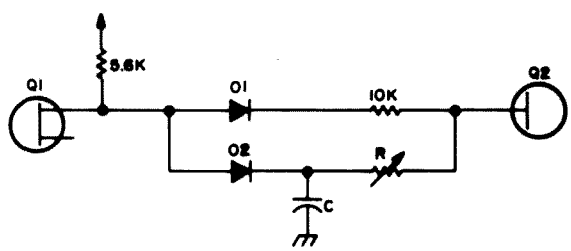


The first transistor stage utilizes a MOSFET with an extremely high input impedance. This feature allows connection to nearly any receiver with a minimum of loading. A negative going voltage of more than −3V is required to activate the COR. This voltage can normally be obtained from within the receiver squelch circuitry. With no received signal V_{in} should be approximately 0V.

R_1 and R_2 are chosen so that the gate to source voltage (V_{gs}) is at least −3V with a received signal. But not more than −6V. For V_{in} in the range −3 to −6V R_2 may be eliminated. Typical values are in the range 1−10 MΩ. Q_1 is conducting sufficiently during no-signal conditions to prevent sufficient base current from turning Q_2 on. When a signal is received Q_1 is cut off driving the drain potential up and the base of Q_2 receives adequate current to saturate, causing the relay to be activated. Q_2 is a standard NPN bipolar transistor with a high h_{FE} (dc beta). R_3 and R_5 are used to limit V_{DS} to +15V.

For 12V operation, R_3 and R_5 are eliminated, R_6 is reduced to 5.6K and a 12V relay is used.

With the addition of only 4 components the COR can be given a variable release (hold timer) function. Shown schematically below the relay can be set to provide up to 30 seconds or more of hold time after the carrier has disappeared.



D_1 and D_2 are 50 PIV 100AM diodes. The hold time is determined by the RC product. Typically, the C of 200 μF and R of 5K the hold time was 10 seconds. Values will differ from transistor to transistor and should be determined experimentally.

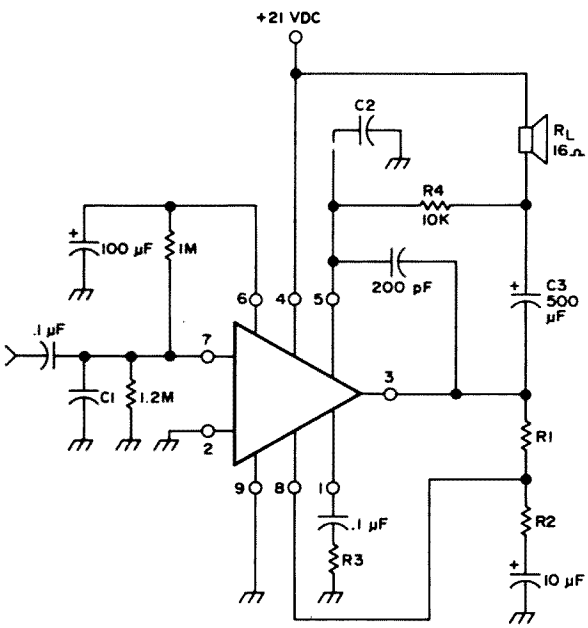
This solid state COR should provide you with a low power (.4W max) yet flexible device for your repeater or other carrier signaling functions.

. . . .KØMOC

CIRCUITS, CIRCUITS, CIRCUITS...

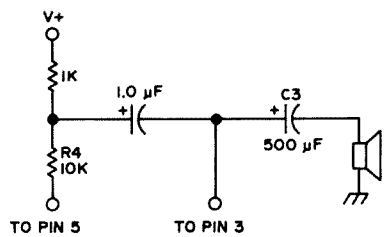
The following circuits have appeared in the referenced books, magazines, application notes, etc. While we try to reproduce all of the information that should be needed by an experienced constructor, readers may want to avail themselves of the original sources for peace of mind.

Readers are requested to pass along any interesting circuits that they discover in sources other than U.S. ham magazines. Circuits should be oriented toward amateur radio and experimentation rather than industrial or computer technology. Submit circuit with all parts values on it, a very brief explanation of the circuit and any additional parts information required, give the source and a note of permission to reprint from the copyright holder, if any, and the reward for a published circuit will be a choice of a 73 book. Send your circuits to 73 Circuits Page, 73 Magazine, Peterborough NH 03458.

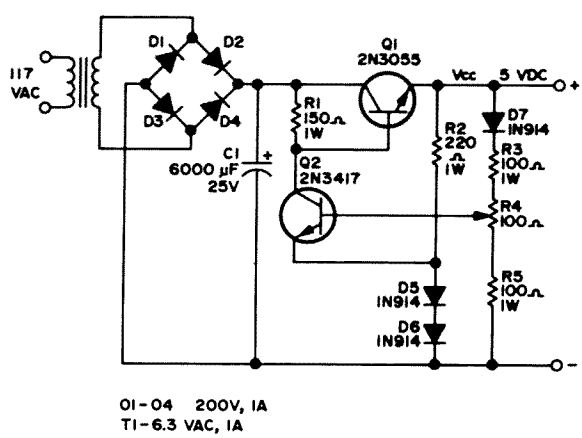


SENSITIVITY FOR P_o mV	C1 pF	C2 pF	R1 k OHMS	R2 OHMS	R3 OHMS	R_L OHMS	P_o W
560	0	0	10	1.0K	82	8.0	4.0
15	100	100	51	100	2.2K	8.0	4.0
630	0	0	10	1.0K	62	16	2.5
17	100	100	51	100	2.2K	16	2.5

Alternate connection to permit connecting speaker to ground instead of to V^+:

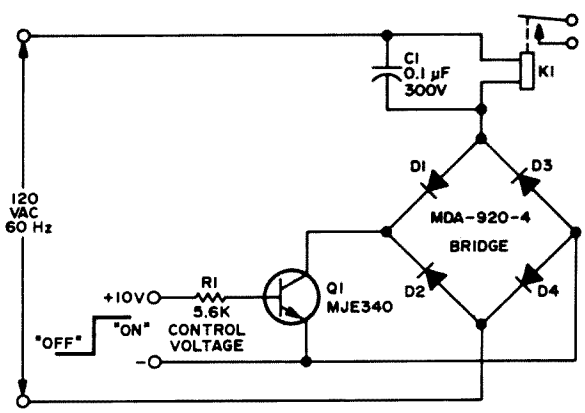


Motorola Functional Circuit MFC9000, in a typical application. This solid-state device is a 4-watt audio amplifier designed to provide the complete audio system in T.V, radio and hi-fi equipment. Circuit courtesy Motorola MFC Handbook.



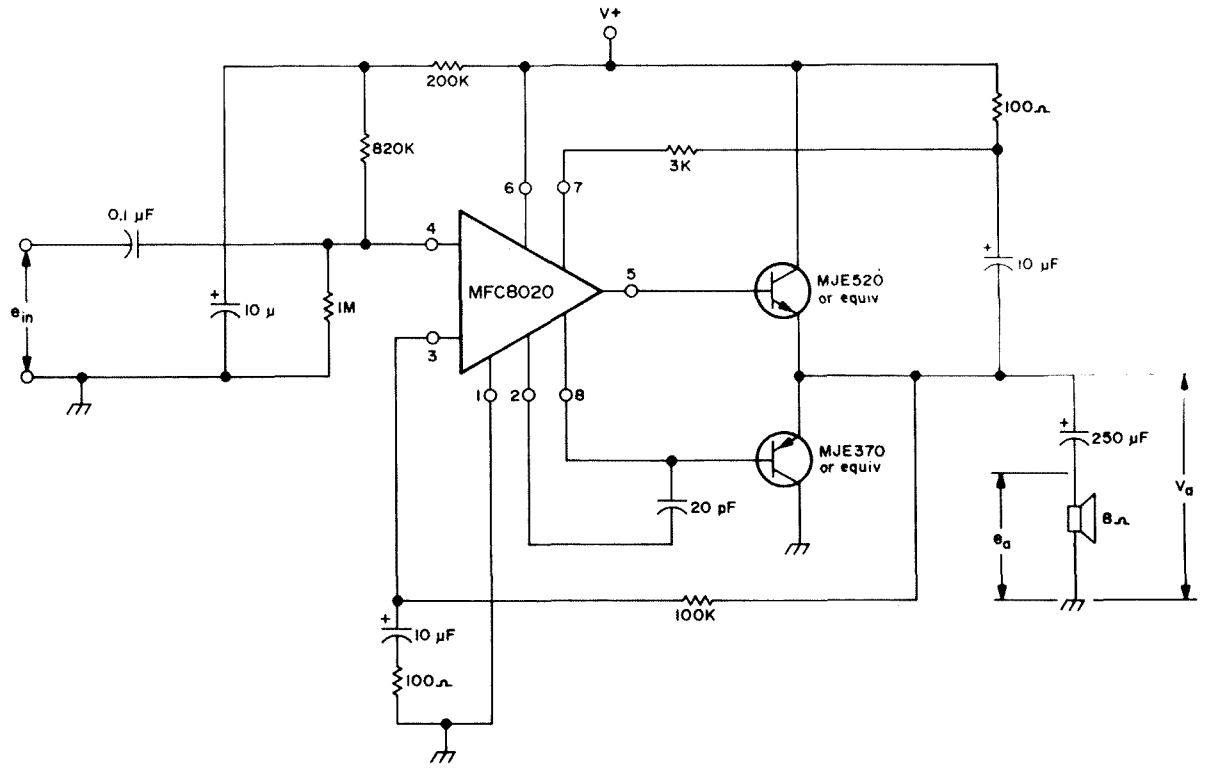
D1-D4 200V, 1A
T1-6.3 VAC, 1A

Regulated 5V power supply for ICs, by VE7BWF, reprinted from "Zero Beat," published by the Victoria Short Wave Club, Victoria, British Columbia.

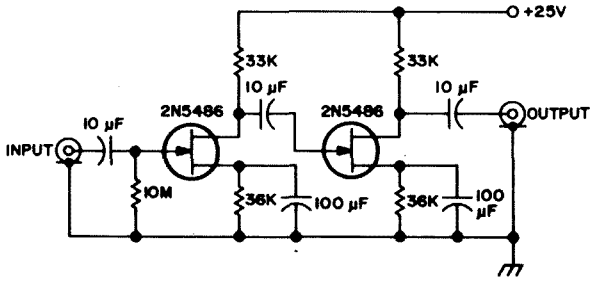


K1-POTTER & BRUMFIELD NO. KA5A6

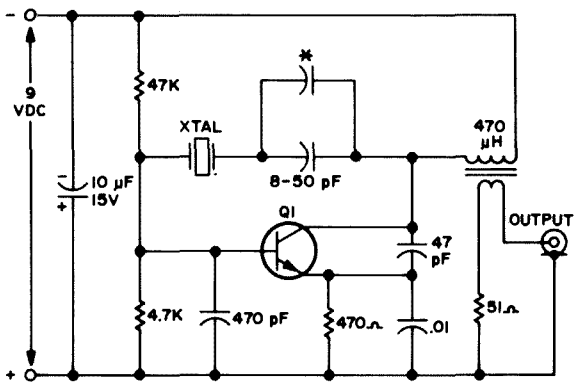
Electronic control of an ac relay with less than 2 mA current required to operate. Circuit courtesy Motorola Semiconductor Power Circuits Handbook.



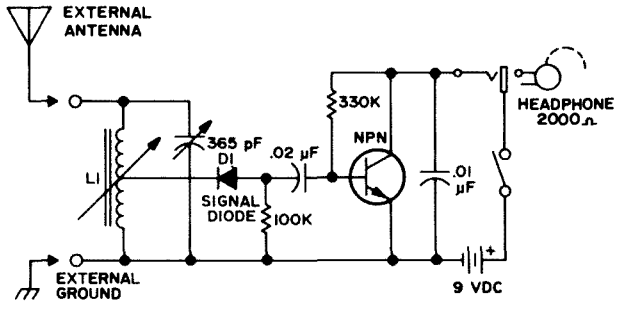
Typical application and test circuit (10-watt amplifier) using a Motorola MCF8020 class B audio driver silicon monolithic functional circuit. The MFC is designed as a preamplifier and driver circuit for complementary output transistors and will drive up to 15 watts output (4 ohm load). Application circuit courtesy of Motorola Functional Circuits Handbook.



Low frequency preamp 1 Hz to 50 kHz, voltage gain 400, extremely low noise, all capacitances in μF, all resistors ½W, transistors 2N5486. Circuit thanks to WA3EEC.

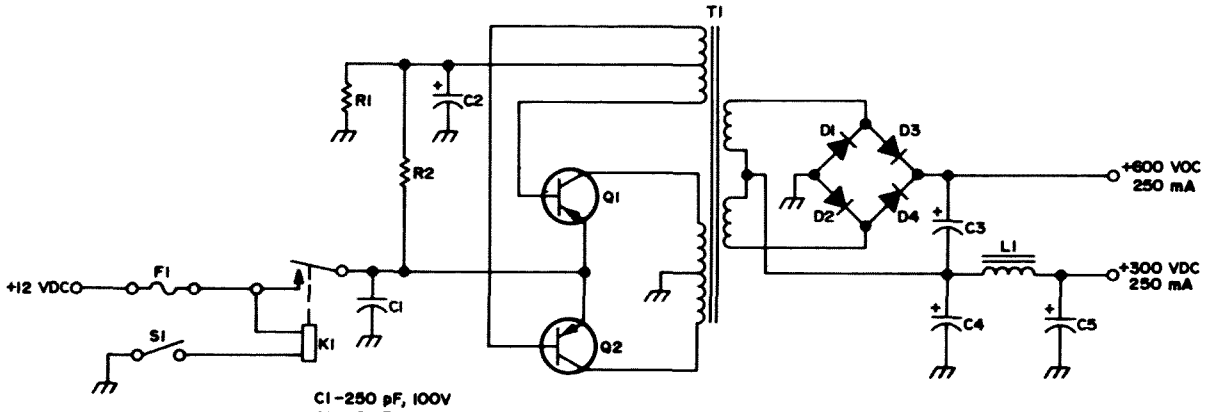


Q1 – VHF PNP (GE-9, ES19, etc)
* – MAY BE NEEDED IF TRIMMER WILL NOT ZERO-BEAT. ADD IN 50 pF STEPS.



One-transistor radio. Works on local broadcast stations. Amuse the Jr. op. Circuit courtesy Calectro Handbook. L1 is a ferrite variable antenna coil (Calectro D1-841). D1 is and signal diode (Calectro K4-550).

Two meter crystal oscillator. The transmitter crystal is used, the netting capacitor is adjusted so that the crystal is zero-beat with someone who is considered as being on frequency. Then the oscillator may be used to align a receiver. Since the output is so high (measured 18 volts peak to peak across the choke), it must be loose coupled to the receiver. This is done by winding two turns around the choke. One end of the winding is connected to the connector; the other end is connected to a 51 ohm resistor, which is then connected to ground. This circuit is very active and will handle crystals from 2 MHz to 30 MHz. (Thanks to VE7AZH.)



Mobile transceiver power supply (from The Keyer *Ventura County ARC). 12V in, 600V @ 250 mA and 300V @ 250 mA out. Mount transistors on heatsinks.*

INDEPENDENT RECEIVER TUNING FOR TRANSCEIVER

Did you ever wish you could tune the receiver section of your transceiver without changing the transmitter frequency? Sure would be nice on CW for setting the tone of the station you are working, or for SSB roundtables where everyone never seems to be on the same frequency. It is extremely simple to do if you have an extra set of contacts on your TR relay in the transceiver, or room for another relay. Stability is not affected; however, the vfo must be recalibrated. Such a device has been in use here for about three years, and I would be lost without it.

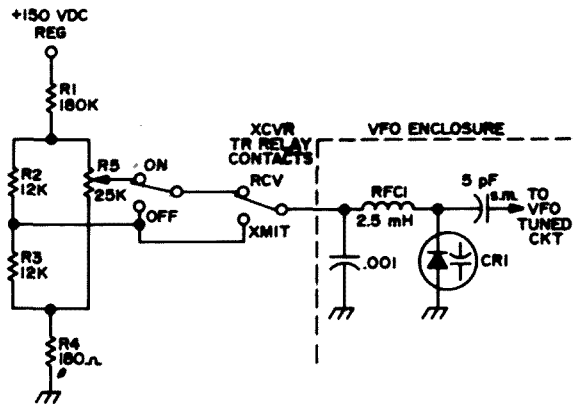
Referring to the drawing, CR1 is a Varicap Diode Motorola MV1642 or Hughes 1M954. It changes capacity as the voltage to it is varied (working like a variable capacitor). When transmitting, the diode is given a steady voltage from the voltage divider R1, R2, R3, R4. When in receive, the potentiometer R5 is supplying the voltage to the varicap. With R5 in the center of its range, the control voltage is about the same as in transmit, so there will be no offset. Moving R5 above or below center will tune the receiver plus or minus from the transmitter frequency. Switch S1 bypasses the offset control and allows normal transceiver operation.

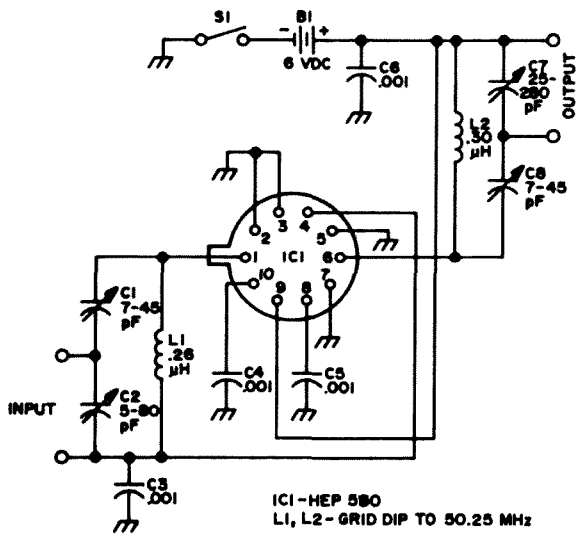
C1, C2, RFC1, and CR1 should be mounted inside the vfo enclosure. The other components can be anywhere, including a separate box outside the transceiver. Recalibrate the vfo with the switch in the off position. As shown, the offset is about 2 kHz. If you want more offset control change C2 to 10 pF.

I hope receiver offset will increase your operating enjoyment as much as it has mine. Cost is $6 or $7 if all parts are new.

. . .W2FBF

Circuit courtesy WCRA SCOPE.





Six meter pre-amp with 30 dB of signal gain and 600 kHz bandwidth. The input and output impedances are matched. AGC may be added to pin 5. For FM use dip the coils to 52.5 MHz. Circuit from Motorola HMA-36, Radio Amateur's IC Projects, available free from Motorola, Dept. 73, Box 20924, Phoenix AZ 85034.

R. B. Kuehn WØHKF
1212 Bellows Street
West St. Paul MN

SIGNAL REPORTING -A RECAP

Like all of man's methods of measurements, our RST (readability, signal strength, and tone) system for giving signal reports have come down to us through a long and painful evolution. The fact that it has been used, unchanged, for more than a quarter century, indicates that the end product has been pretty successful.

There were lengthy times of mild confusion when, in transitional periods, more than one code was in general use before blending into another. It also took a long time for the idea to emerge that readability and signal strength had to be treated as separate entities.

Any ham with enough whiskers to join the Old, Old Timers Club (I.E., licensed 40 years ago), will recall the original R scale (for readability), also known as the Eccles code:

R1 Faint signals, just audible
R2 Weak signals, barely audible
R3 Weak signals, copyable in the absence of any difficulty
R4 Fair signals; readable
R5 Moderately strong signals
R6 Strong signals
R7 Good signals, such as copyable through interference
R8 Very strong signals, can be heard several feet from phones.
R9 Extremely strong signals

There may have been older reporting systems in ham radio, but this one was proclaimed official by *QST* in 1925 and must date back at least to World War 1. Its long-term impact on the art may be shown by the fact that it wasn't until the end of World War 2 that our receivers' carrier strength indicators were called S meters rather than R meters! But as the state of the art grew more refined, dissatisfaction also grew because, although the Eccles code was supposed to indicate readability, the definitions were much more concerned with signal strength. It was also pointed out, in later years, that on a receiver with a number of audio amplifier stages, almost any old signal could be made to conform to the R8 requirements by simply cranking up the audio gain.

Along about 1926, RCA originated a system known as the Traffic Frame Code, primarily intended for use by commercial cw stations. The word "Frame" indicated the order in which the five section report was to be given, that is, Frequency, Relative Strength, Amplitude Modulation, Musicality of note, and Estimated readability. Since each of the five sections contained nine graduations, it's just as well that this one was speedily forgotten. But the Frame code was indeed an important part of the family tree because the M for Musicality of note section was lifted in toto to become the T for "Tone" part of our R-S-T code. Witness the original nine parts with the frequent references to musicality:

1 Extremely rough, hissing note
2 Very rough ac note, no trace of musicality
3 Rough, low-pitched ac note, slightly musical
4 Rather rough, ac note, moderately musical
5 Musically modulated note
6 Modulated note – slight trace of whistle
7 Near dc note, smooth ripple
8 Good dc note, just trace of ripple
9 Purest dc note

It's most interesting to note that these nine definitions of a cw note have served us for 40 years without a single word having been changed!

Another early system of signal reporting, intended for use by the then relatively few phone stations, was the Q for Quality code of five divisions:

Q1 Good quality, no hum or distortion
Q2 Good quality, but noticeable hum
Q3 Fair quality because of distortion
Q4 Poor quality because of bad hum
Q5 Poor quality because of bad distortion

From this it may be inferred that hum and distortion were a common part of radiotelephony in those days, which is indeed true (as those of us who were there will attest). If it had been possible to do so, microphones and filter capacitors would have literally been cheaper if fabricated from gold rather than carbon granules and tinfoil.

Meanwhile there evolved a five point reporting system based on the international code signal QSA, "The strength of your signals is . . . " Its final form as adopted by the 1932 Madrid Conference was:

QSA1 Hardly receptible – unreadable
QSA2 Weak, readable now and then
QSA3 Fairly good, readable with difficulty
QSA4 Good, readable
QSA5 Very good, perfectly readable

Even though, here again, readability and strength were somewhat interwoven, these five steps are easily recognizable as the direct ancestor of the R for "Readability" part of our R-S-T system.

Although at the time of its inception, the QSA code was intended to supplant the older nine point R system, hamdom was unaccountably cool to the idea and blithely proceeded to use them both at the same time. During that period, as old-timers will recall, a moderately good phone signal might have been reported as QSA 4 R7 – good signals, such as copyable through interference.

CW stations used the same procedure except the report was preceded by a simple abbreviation to indicate tone, i.e., RAC for rectified ac (or raw ac), NDC for near dc, DC for a nearly pure whistle, and, best of all, PDC for pure, direct current. If the piercing quality of crystal control was evident in those days of mostly self-excited rigs, an X was tacked on ahead of the appropriate group. Thus, a pretty good report in any CW man's log was "Ur XPDC sigs QSA 5 R7 hr, OM."

And so the stage was set for the final (almost) attempt to set up a workable signal reporting system with readability, signal strength and tone in three entirely separate categories.

The first description of the R-S-T code, together with the announcement of its adoption by the ARRL, appeared in *QST* for October, 1934. The readability and tone sections of the new code as then set forth were exactly as they are today – remarkable when one considers the technical changes which ham radio has undergone during the intervening years. As proposed in 1934 the S for strength portion contained only 5 steps:

1 Faint – signals barely perceptible
2 Weak signals
3 Fairly good signals
4 Good signals
5 Very strong signals

Long accustomed to the multiple possibilities offered by the old R1 through 9 code, the fraternity voiced immediate dissatisfaction over this new, apparently oversimplified version. Also "R" meters were just becoming available on superhet receivers and the gaps between S points looked very wide indeed.

Consequently, only one year later[1] in October, 1935, four additional steps were interspersed to bring the total up to the magical nine total. The added steps: very weak signals, fair signals, moderately strong signals and strong signals. As an afterthought, S9 was changed to "extremely strong signals."

During the years since then, there has been no end to the argument over what constitutes an extremely strong signal. Perhaps our new friends, the Citizens Banders, have the answer – they've simply added an "S10!"

. . .WØHKF

[1] Curiously, although the arrangement was officially in use for only a year, it gave rise to the abbreviated report, still heard occasionally, "Read you 5 by 5" or "5 square."

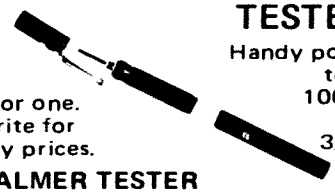
Lazy Lechers

As was mentioned in the article of W2DXH in *73*, July '66, Lecher wire systems are of questionable value. To the average ham this no doubt is a true and irrefutable statement, and of little value to the vhf or uhf experimenter. However, going into the first stages of second hamhood, the author tried out a pair of Lecher wires last winter.

Since some may ask, "What are Lecher Wires?" and, indeed, some have, a brief description might be in order. Please don't try your secretary's dictionary. Nasty-minded insinuations are all you will find. Just take a double man-sized hank of bare shiny wire, bend it back on itself, stretch tight, and apply a shorting bar of some kind. That is a Lecher wire. Simplicity should not be confused with lack of accuracy. For calibration, measure the distance between nulls or peaks, and convert to meters or frequency. This procedure was plenty good on 5 and 2½ meters in isolated spots where the primary need was to insure you were in the band. For more accurate measurements, a sneaky deal was to use the harmonics of the oscillator of a short-wave receiver to calibrate things. Merely add and subtract 455 and multiply. Meanwhile, back to Lecher wires.

An expensive source of workable wire is aluminum clothesline. Plastic clips cost about 10 cents a dozen with mounting screws. A 1 x 2 piece of wood, a few feet long, is the only requirement. For long term stability, a coat or two of shellac or varnish may help. As for the accuracy and calibration, these are really up to the individual. For an example, the sound and video on channel 7 can be very easily separated. 4.5 MHz at this frequency represents quite good resolution for such a simple instrument. Maintenance costs are extremely low. None!

Roy A. McCarthy, K6EAW



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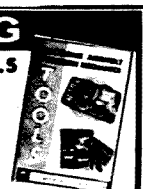
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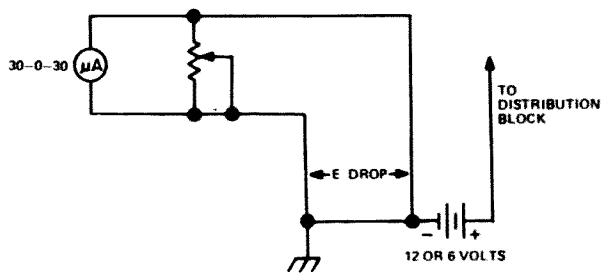
Simple ammeter for your car.

Most amateurs belabor the fact that many of the present day American cars come equipped with those questionably functional "idiot lights." The average amateur, not qualifying as an idiot, finds them extremely difficult to read in determining how much current his rig and other accessories are drawing from an already overloaded battery.

The generally accepted method for monitoring current in a vehicle so equipped is to mount an ammeter somewhere in or on the dashboard, break the dc line at an appropriate place, run a pair of heavy leads through the firewall and connect them to the meter.

This has many disadvantages. The last time I tried this using No. 10 insulated copper wire a voltage drop of approximately 0.7V under a load of 18 to 20 amps was noted, not to mention the job of knocking a large size feed-through hole in the firewall. When installing the old rig in a new car, I decided to take a lazy-type approach to this problem of remotely reading current.

This was accomplished by the simple expedient of inserting a zero center 30-0-30 microammeter from the negative battery terminal to any point on the body of the vehicle where a good ground can be obtained. This has the effect of reading the voltage drop across the negative battery cable which is directly proportional to the current flow. In my case, I found that the meter reading was slightly higher than the actual current. This was proved by inserting a standard 0-30 ampere meter in the dc line and observing the current when the lights or



other accessories were turned on. An ancient wire wound, open type potentiometer was "scrounged" from the junkbox and placed across the microammeter terminals. This was adjusted until both meters read the same. The ammeter was then removed and the dc line closed.

A 10 foot piece of No. 18 insulated wire was then connected to the negative battery terminal. This was guided through the cable hangers and through a convenient small hole in the firewall where it was connected to one terminal of the microammeter, the other terminal going to ground. The pre-set pot was soldered across the terminals. The meter was then mounted in a small panel designed to attach to the steering post.

I now have a device with which I can read current charge and discharge with a fair degree of accuracy.

Remember that this scheme involves wiring that is virtually at the same potential as the vehicle body, therefore the danger of short circuits is non-existent. The main advantages of this simple installation are: elimination of voltage loss at the load; and ease of installation.

. . .W6WDF

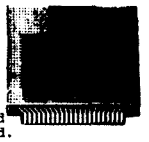
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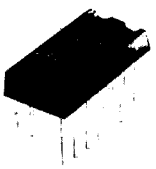
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J. H. Nelson

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May 1972

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	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
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28	29	30	31			

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7A	7	7	7	7	7	7	7A	14	14
ARGENTINA	21	14	14	14	7	7	14	14	21	21	21	21
AUSTRALIA	14	14	14	7B	7B	7	7	7	7	7	14	14
CANAL ZONE	21	14	7A	7	7	7	14	14	14	14	21	21
ENGLAND	14	7	7	7	7	7A	14	14A	14A	14	14	14
HAWAII	14	14	7A	7	7	7	7	7	14	14	14	14
INDIA	14	7B	7B	7B	7B	7B	14	14	14	14	14	14
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MEXICO	14	14	7A	7	7	7	7	14	14	14	14	14
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ALASKA	14	14	14	7	7	7	7	7A	14	14	14	
ARGENTINA	21	14A	14	14	7	7	14	14	14	21	21	21
AUSTRALIA	14	14	14	7A	7B	7	7	7	7	7	14	14
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HAWAII	14	14	14	7	7	7	7	7	14	14	14	14
INDIA	14	14	14	7B	7B	7B	7B	7B	14	14	14	14
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ALASKA	14	14	14	7	7	7	7	7	7	7	7A	14
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AUSTRALIA	21	21	21	14	14	7A	7	7	7	7	14	14A
CANAL ZONE	21	14A	14	7	7	7	7	14	14	14	21	21
ENGLAND	7	7	7	7	7	7	7	7	7A	14	14	14
HAWAII	21	21	21	14	14	7A	7	7	14	14	14	21
INDIA	14	14	14	7A	7B	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	14	7A	7	7	7	7	7A	14	14
MEXICO	14	14	14	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14	14	14	7A	7B	7	7	7	14	14	14
PUERTO RICO	14A	14	7A	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7B	7	7	7	7B	7B	7B	14	14	14	14	14B
U. S. S. R.	7	7	7	7	7	7	7	7	14	14	14	7B
EAST COAST	14A	14	7A	7	7	7	7	14	14	14	14	14

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

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June 1972
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73 magazine

for radio amateurs



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for radio amateurs
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Don't forget the 73 Tour in September. . .send money now for a reservation. Turn to the last page and mark reader's service you want literature from (or send list on your QSL card). Buy a gift subscription for yourself, a friend or even an enemy and get a book per our ridiculously generous subscription offer. Try FM. Try SSTV. Have fun. . .that's what it's all about. It is forbidden to let a friend borrow this issue of 73. . .let him buy his own.

Amateur Radio

JUNE MCMLXXII Monthly Han

HAMS HELP IN TORNADO CRISIS

Louis R. Huber W7UU

A classic demonstration of a monitoring service's capability in an emergency occurred April 5, 1972, when a tornado struck Vancouver, Washington. Six people were killed outright, with hundreds suffering injuries. $6.2 million dollars damage was done by demolition of a school, a supermarket, a bowling alley and portions of other buildings.

The tornado struck at 12:49 P.M., PST. NAMS (Northwest Amateur Monitoring Service) received the first news of the disaster when K7SUX mobile checked in with Monitor Control (W7DFL Tacoma) as 2:18 P.M. "I'm on my way to Red Cross headquarters," he said. That is also the meeting place for the Clark County Amateur Radio Club. K7SUX contemplated putting the club station on the air; however, it was out of order and he continued to do what he could as a mobile. Later the club station (W7AIA) did get on the air with a transceiver brought down by WA7MQC.

With the first raw news of the disaster from K7SUX, NAMS' cogwheels jumped a bit – wonderment at first, than casting about as to what best to do. WA7NVF and W7ZF in Portland, Oregon (across the Columbia River from Vancouver) were well aware of the vicious wind because of torn-off shingles and other debris flying about. They were on the air along with W7UU, Seattle, and Monitor Control W7DFL.

A local control station was set up on 3960 kHz, with NAMS keeping on as usual on 3970.

About this time WA7KKC, Vancouver, was driving in the tornado-struck area. He had to detour around the devastated area to reach his home and so he knew almost precisely the limits of the devastation. "I'll take it and go down to 3960," said WA7KKC, as soon as he got on the air. This was at 2:40 P.M., less than two hours after the "killer wind" struck. Bill Tuominen WA7KKC, has been a licensed amateur only a little over two years. His performance in this instance, and for the next three days, leaves no doubt as to his proficiency – it was tops!

WA7KCC's son, Monty, was home on vacation from college. He spread out a map of the city and circled the devastated area. "Give us addresses," said WA7KKC, for health and welfare inquiries were already coming in, "and we'll see if they're in the disaster area. That's the best we can do right now."

Bill estimates that somewhere around 1,000 inquiries were handled that same day over his station and others in Vancouver. Something less than that during the next day, plus a few stragglers on the third and fourth days after the disaster. There were probably 2,000 or more such calls. Telephone service was destroyed in the devastated area and remained out locally until mid-afternoon Friday, although some telephones got into operation slightly before then. Incoming long-distance calls were met by a recorded announcement during this period so amateur radio was the only way relatives had for finding out how their kin had fared.

WA7KKC was on the air continuously until 6:30 P.M., a stretch of four jampacked hours. He then drove over to the Red Cross headquarters. By this time W7AIA, the Clark County Amateur Radio Club station, was on the air by means of WA7MQC's transceiver. Bill manned the city map at the club station, checking out addresses one by one as they came in.

Mid-evening brought some phone-patch activity through other Vancouver ham stations; W7EEA, who is totally blind, handled a number of them with great efficiency on 3950 kHz. WA7OAS, Sally, an XYL, with other Vancouver hams had two-meter gear in operation for Vancouver area operation – especially with mobiles. The latter included K7SUX, W7SNY, K7SUQ and others.

The mobiles were used for various chores, checking out details and providing communication where needed by the Red Cross crews.

Although NAMS ceases operation at 5:45 P.M. daily, the 3960 kHz NAMS emergency operation kept right on throughout the night and into the next morning until about 2:00 A.M. Two nets, Columbia Basin and Northwest Eyebank, which normally use 3960 kHz, graciously moved to other frequencies so NAMS could continue its work uninterrupted.

From other points in the Pacific Northwest and West, health and welfare inquiries originated through a large number of ham stations who got in touch with their local Red Cross offices, where such inquiries are placed.

The cooperation of all NAMS members and non-members proves the reliability of this kind of service and the efficiency with which hams can mobilize to perform emergency communications.

HAM OPERATORS AID TANKER

Two ham radio operators who established communications with the Military Sealift Command's *USNS Cossatot* after the ship's system failed have been commended by Marine Transport Lines, Inc., operators of the tanker. John Previtera WB2BAR, Bronx, N.Y., and William Taylor WA3HRO Thorton, Pa., answered *Cossatot* Captain Finn Bjorney's call for assistance, and established a connection with the company's home office in New York City. The tanker was directed to Trinidad for repairs. *Reprinted from the Military Sealift Command Newsletter.*

News Pages

BY NOAA

$1K RADIOTELESCOPE

Scientists of the Commerce Department's National Oceanic and Atmospheric Administration have developed a radio telescope array which observes radio stars and upper atmosphere discontinuities simultaneously.

Moreover, the instrument is so economical, with a hardware cost of approximately $1000, that it should bring important new radio astronomical and ionospheric studies within the reach of universities and private researchers, large and small.

The present NOAA array consists of 16 small zigzag antennas with a signal-combiner. Conceived for the purpose of studying small-scale irregularities of the ionosphere, it was designed and developed by Dr. Clifford L. Rufenach, Dr. Willard M. Cronyn and Kerry Neal, of NOAA's Space Environmental Laboratory, Boulder, Colorado.

"Radio astronomical observations at frequencies less than 100 MHz normally require huge antenna arrays," Rufenach said. "The prototype telescope array which we built allows us to examine the ionosphere at many different radio frequencies simultaneously."

The new NOAA radio telescope design represents an advance in observational flexibility. Each element is triangular in shape with a wire zigzagging from the narrow top to the broad base. A radio wave coming down over the triangle is picked up by an appropriate length of the zigzag wire whose active portion is about one-third of the radio wavelength. Different wavelengths may be picked up by different lengths of wire simultaneously. The present array can receive radio wavelengths between 3 and 12 meters.

Absorbed radio energy travels up the zigzag wire of the element into a line that carries it along with the signals from the other 15 elements, into a central signal combiner that amplifies the output of the array.

Large-scale disturbances occurring in the ionosphere have long been interesting to scientists because they affect the quality and, at times, the feasibility of radio communications on earth. Such ionospheric disturbances can cause short-wave fadeout and signal distortions. A fairly regular fluctuation in the ionosphere's electron density results from atmospheric tides produced by the sun and the moon. Erratic ionospheric disturbances can be caused by meteors, solar flares, and magnetic storms.

Small-scale ionospheric irregularites are often related to the larger-scale upheavals, but the exact relationship is not always clear. These small-scale fluctuations in electron density affect trans-ionospheric radio communications from satellites to earth. This is particularly significant in the equatorial and polar regions where scintillation at super-high frequencies (1.5 to 6 GHz) are sometimes harmful to communication channels.

Defining "small-scale" as any irregularity less than about 2 kilometers in size, Rufenach says: "We wanted to look simultaneously at the various dimensions involved in small-scale irregularities. We first set out to design a small scale prototype radio telescope. Our initial observations with this 16-element array have been very promising."

The prototype radio telescope is located in the mountains behind the front range of the Colorado Rockies to avoid radio and television interference.

The broad-band multi-frequency radio telescope also offers a technique that should find future applications in solar radio astronomy and interplanetary scintillation studies.



73 HILTON?

Lee Wilkinson WA4QXC, was the first guest at the new motel in Tennessee. Each room has independent beam antennas, a full kilowatt on each band, and long-term guests can use FM hand held units while visiting. Stop by for a visit but keep your cameras ready; we move fast.

RED CROSS TEST

The Elkhart Red Cross ARC held an emergency test of its communication facilities on March 26. Making use of the K9HDH club repeater, several mobiles were directed to special assignments while base stations were on handy call via 94 direct to relay messages to hf nets. The emergency center was a specially prepared trailer that the club set up for Field Day, 1971. W9FJA and WA9WYY coordinated the projects. Participants were mobiles K9SRI, K9ADF, WB9BFU, WA8CEN, K9FUP; bases WA9RNT, K9FAP; headquarters K9IXB.



WA9WYY in communications trailer during emergency test.



W9FJA keeping track of mobile's location during emergency test.

GOOD NEIGHBOR HAMS



Here are the hams who founded the SIRA (Sociedad Internacional de Radio Aficionados) on Dec. 4, 1971, in Miami, Florida. They also elected a provisional Board in order to elaborate the Articles and By-laws. Seated left to right are: WN4VQH Orlando Martin, Treasurer; HK3CJD German Ordonez, Delegate; HK3CAB Hernan Melo, Secretary; WA4ZZG Rafael M. Estevez, President; WB4TED Tony Urbizu, Delegate; and HC2IP Hector Patino, Delegate. Standing left to right: CO2AB Genaro Rguez., WN4PXA Marta Estevez, CO2VE Publio Maldonado, WB4SNC Alberto Coya, SWL Edgar Bueno, YN1AEO Adrian Espinosa, CO5TM Tomas Munoz, WB4JSS Mike Caruncho, CO3JR Raul Fdez., WN4VSX Eduardo Glez., WN4UIL Jorge Quintero, K4CAG Carlos Hdez. and TG9MP Rene Alvarez. Picture taken by HP1FH Fernando Henrique. The SIRA welcomes any radio amateur who wishes to join their Society. Mailing address is SIRA, P.O. Box 71, Miami International Airport, Miami FL 33148.



Here is a partial group of Latin and American hams who attended the Annual Luncheon. They usually meet and lunch the last Sunday of the year since 1968. There were 64 persons at the last one. Hams from VE3, CO2-3, 8, YV5, HI8, HC2, HK3, TI2, W3, W4, KP4, YN1, LU3 and TG9 were at the luncheon. Picture was taken by WB4SNC. Release by Rafael M. Estevez WA4ZZG, P.O. Box 2442, Hialeah FL 33012.

STANDARD COMMUNICATIONS IS OKAY!

The instruction booklet that comes with the new SR-C146 transceivers is the first that we have seen which recommends the use of 146.52 for simplex operation . . . hooray! It did not cool our enthusiasm to see 73 and several 73 books given as prime refer ences on using FM.

73 AGAIN

Readers will no doubt be whelmed to hear that a "quiet" snowmobile engine has been announced by the Outboard Marine Corp. This dandy has a sound output of "only" 73 dB at 50 feet distance when running full throttle. Isn't that somewhere in the range of sound that can cause permanent damage to the ear? *(Thanks to K9MGX)*

2ND WORLDWIDE SSTV CONTEST RESULTS

Sponsored by *cq elletronica Magazine*, 5–13 February 1972.

	A	B	C	D
W9NTP	80	40	63	7.560
PAØLAM	75	60	50	6.750
VE3GMT	85	40	51	6.375
I6CGE	80	50	38	4.940
W4MS	60	30	53	4.770
G5ZT	75	40	41	4.715
F6AXT	65	40	39	4.095
W5PPP	50	50	40	4.000
I2KBW	80	50	30	3.900
K9BTU	40	30	45	3.150
F9XY	45	30	24	1.800
I5BNT	45	30	24	1.800
I5CW	50	30	19	1.520
SMØBUO	45	40	17	1.445
I1ROL	55	30	16	1.360
W1JKF	25	20	27	1.215
EA4DT	40	20	20	1.200
W5QKR	30	10	28	1.120
SV1CG	35	20	15	825
WB2MEX	25	30	15	825
K4TWJ	25	20	18	810
VK5MF	40	40	10	800
W7FEN	15	10	30	750
I5CG	45	20	11	715
WB6OMF	15	10	25	625
W1FUQ	30	30	9	540
W5GQV	15	10	17	425
EA4KJ	20	20	10	400
FOBDO	20	20	8	320
K6IV	15	10	12	300
WB6ZYE	10	10	15	300
G3ZGO	15	10	11	275
OD5BV	20	10	8	240
OZ6PH	15	10	9	225
F9AC	5	10	2	30
I1LCF EA8CI	75	50	18	–
		S.W.L.		
I1BAY	90	40	46	5.200
ON4BX	75	30	33	3.465
WDX4IKZ	35	30	31	2.015
I1RAR	40	30	10	700

A – Country
B – Continent
C – Contacts
D – Score

WARNING!

Word comes in, certain unscrupulous antique dealers are pawning off fake radios to the public.

The new wave of interest in old battery sets generated by erroneous publicity in various publications has prompted these characters to doctor up old junkers with anything handy: rheostats replacing holes where once was mounted a variable condenser, dials and hardware from other brands, modern tube sockets for UV, unseasoned wooden breadboards and cabinets, steamed off stickers re-glued, replaced nameplates and other amateurish attempts to sell a "rare" old battery set!

Reprinted from the Old Timer's Bulletin.

TVI ESCALATION

Reprinted from the Pack Rat's Cheese Bits

The following is extracted from a complaint filed in Common Pleas Court of Philadelphia against one of our club members.

For a period in excess of three years, defendants have systematically harassed and persecuted plaintiffs without reasonable cause or justification as follows:

Since 1966 defendant has operated a wireless radio set at his residence which interfered with the picture and voice on plaintiff's television set. Plaintiff's complaints over this interference with their quiet enjoyment of the television set in their home has caused defendants to engage in a course of conduct, vilification and harassment, intended to cause plaintiffs to move from their residence.

Since 1966 defendant has engaged in the unlicensed and unauthorized sale and repair of wireless radio receivers and television sets at his residence, thereby causing the common driveway to be filled with automobiles so that plaintiffs were denied the right of entrance and departure.

In the summer of 1966, attempted to enter plaintiff's residence and claims to have authority under F.C.C. regulations to search their residence to remove the thermostat from plaintiff's refrigerator and air conditio ner because they interfered with the reception of his wireless radio sets.

Defendant often takes pictures of plaintiffs with a camera to confuse, intimidate and harass them. Since this time defendants have cursed plaintiffs on many occasions and addressed loud and abusive language and threats at them.

Since 1966, defendants have constantly and repeatedly banged on the party wall of their home, slammed the door, as well as banged on piano keys, thereby interfering with plaintiff's quiet enjoyment of their home.

Since 1968, defendants have called plaintiffs foul and vile names on many occasions.

In the fall of 1966, defendant attempted to strike plaintiff Josephine with a motor vehicle on several occasions. Defendant attempted to push a baby coach into a collision with a motor vehicle being operated by plaintiff John

Every summer since 1966, defendants repeatedly and constantly hosed the common pavement from the front doors to the street with great and excessive amounts of water causing plaintiffs to get their shoes wet in order to leave or return to their home.

Since 1966, whenever defendants dumped the water from their portable swimming pool, they would cause the water to flood plaintiff's lawn.

Defendants teased and harassed plaintiff's father (now deceased) whenever he was outside tending to the lawn or shrubbery by siccing their dog on him and by calling him names.

Since 1966, defendants constantly honk the horn of their car to harass plaintiffs. They operate their car at great speed and screech to a halt in front of plaintiff's home and blow the horn loudly and repeatedly. They follow plaintiffs in their auto whenever plaintiffs leave their home.

On Sunday, July 6, 1969, defendants had a lawn party wherein defendants and their guests amused themselves by throwing firecrackers at and against plaintiff's residence, thereby interfering with plaintiff's quiet enjoyment of their home and causing them to become fearful and apprehensive. On this occasion, the defendants said "I wish this was a bomb." One of the defendant's guests said "I wish they would come out. I could take care of them and make it look like an accident."

Defendants have often expressed their intention and desire to frame plaintiffs and have them arrested. In July 1969 defendants falsely accused plaintiffs of having stolen their cat and caused a policeman to search their home and garage for the cat.

Defendants operate an electric gasoline generator in their garage which emits noxious fumes which seep into plaintiff's home.

All of the above specified actions of the defendants have caused plaintiffs to become nervous, upset and ill, to lose sleep and peace of mind, to spend substantial sums of money for counsel fees, all without reasonable and probable cause.

Wherefore, plaintiffs bring this action in the nature of a Bill of Peace and pray the Court to:

a. Enjoin defendants from further harassment or persecution of the plaintiffs, from trespassing upon or damaging plaintiff's property and from threatening or assaulting plaintiffs.

b. Direct that defendants pay the costs of this suit.

c. Grant such other relief as may appear proper to the Court under the circumstances.

You see what a TVI complaint can lead to. After you finish laughing about the charges, consider several things:

1. An attorney will have to be retained to defend the suit (approximately $1500).

2. It could have been you.

K3JJZ

TECHNICAL AID GROUP

The Technical Aid Group is a band of volunteers who offer their services to those who are befuddled with troubles. When making a request, please use an SASE. For more members with their speciality areas and information on joining the TAG, see March '72 *73.

Allen Hochstetler, WA4HNX, 1524 Valencia St., Clearwater FL 33516. Allen is able to help anyone with HF transmitter and receiver problems, solid state matters, and ICs. Allen is also able to locate needed parts.

Please do not forget to include an SASE when writing to TAG members, as they are strictly volunteers and it is not fair to make them spend lots of postage money when they answer lots of questions.

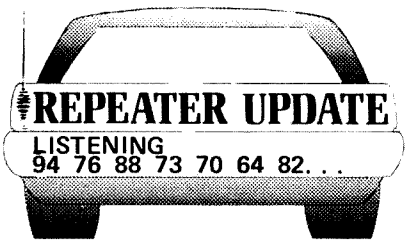


In Memorium — James R. Lightfoot, WA1KRN

Word was received on ECARS March 20th of the sudden passing of one of the founders of ECARS, Jim Lightfoot. Jim had a massive coronary attack at the age of 35. He will be missed greatly by all his friends. Jim, along with the late K1LTO and WA3GAL, was one of the original triumvirate that got ECARS started one wintry day a few years back.

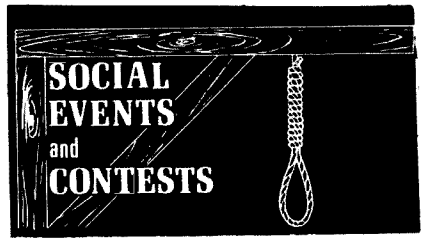
The press of his job as general manager of WBZ in Boston became too great to continue editing and publishing the ECARS Monitor as well as maintaining all the ECARS membership records. He did continue printing and mailing the Monitor. It was only when WA1KRN became President of Firestone Communications and moved to the New York City area that he had to sever fully his working connections with the service, but he continued to be as active as possible on the air and to support the service in every way possible.

Jim just recently moved to San Diego to take over a broadcast station there, and it was in California that he passed away.



CA	WA6ZQD (formerly K6LY)	Monterey	37–97
CO	KØPHF (Delete)		
CT	WA1OHR	Ellington	04–64
CT	K1IIC	Avon	28–88
			221.02–224.02
CT	K1TBA	Hartford	221.86–224.86
CT	WA1JTB	Bridgeport	.295–.895
CT	K1IGF	Groton	07–67
GA	K4SEX	Newnan	19–79
IL	WA9EAE	Oaklawn TB	46–88
IN	WA9HRK (Delete)		
IN	K9LEH Soon to be K9LPW	Indianapolis	16–76
LA		Shreveport	31–91
LA		Shreveport	22–82
MA	WA1LEM	Waltham	49–709
NJ	K2TYV/2	Denville	146.385–146.985
NM	W5SRW	Las Cruces	145.30–146.94
NY	K2AVP	Valhalla	145.68–147.06
			221.50–224.50
NY	W2FWG	NYC	07–67
NY	WA2UWS	Rome	28–88
NY	WB2SEQ/2	Yonkers	221.74–224.74
NY	WA2KEC	NYC	40–995
OH	WA2NVT	Whiteface Mt.	221.86–224.86
OH	K8ALB	Toledo	10–85
OH		Toledo	20–80
OH		Toledo	UHF
PA	WA3KUV (Delete)		
PA	W3ZLO	Erie	34–94
			19–94
TN	WA4JSX	Nashville	145.75–449.65
TN	WB4QFW	Nashville	16–88
TN	WB4QES	Nashville	28–76
			52.920–52.525
			449.45–448.45
TN	W4RFR	Nashville	34–94
TN	WA4YND	Nashville	146.70–147.70
TN	WA4TOA (formerly W4AY)	Nashville	10–64
TN	WB4EKI	Nashville PL 114.8 Hz	40–700
TN	WB4QEY	Gallatin	146.04–147.18
TX	W5NEC (Delete)		
TX	WA5YTO	Austin (Delete UHF) Add	34–94
TX	WA5YZD	Austin	449.1–444.1
WI	W9AIQ	Sturgeon Bay T 1.95	16–76
CANADA			
Nova Scotia			
	VE1JB	New Glasgow	46–94

Thanks to W3ZLO, K9DKW, WA1OJX, NERA, VE1SH, WA8ZID, K2IXN, W5ZBC, K4IKV, WN6LQQ, W9RSV, WB4EKI, WA2ROJ, W2LOY, WBØDMQ, W9HTK, W5EZM.



FM WEST, the First Annual Western Amateur FM Conference, will be held in conjunction with the California Amateur Relay Council meeting on June 2–3. Friday night's champagne party and the Saturday technical talks and exhibits guarantee an excellent program. Saturday's banquet, a scrumptious affair, will be followed by door prize announcements and individual repeater movies and talks. The conference will be held at the Tropicana Lodge, 4061 N. Blackstone, Fresno. Motel reservations must be made before May 20, and specify you are attending FM West. Contact WB6OSH for more information.

CALIFORNIA FM SCENE

Bob Greenberg WB6INR/6

The FM scene in Los Angeles has gained a certain degree of infamy, due to the rapid, unorganized growth of FM in the last few years. It is well known that the Southern California area has had numerous problems with desensitization, simultaneous frequency use by different modes, intermodulation, etc.

According to a survey done in November, 1971, by Jack WA6JXG, there are at present the following repeaters in L.A.: 4 open FM, 3 closed FM, 2 AM, 1 RTTY, plus an additional 8 others proposed (plus innumerable remote base stations). There are also 10 open FM repeaters and 3 proposed within a 150 mile radius of L.A.

Of the 20 operating repeaters in Southern California, only two are on standard 600 kHz spacing and standard channels. All the others are on channel pairs that most likely are unique to this area.

There are rumors of a Repeater Owner's Council of some sort being formed, but at present, no such organization exists. It should be pointed out that if we don't organize soon, there will be at least eleven other repeaters to consider in the near future.

Interesting activities have been occurring on WB6ZDI, the Palisades Amateur Radio Club's Repeater. The PARC Repeater operates on 146.61 in, 147.33 out, and has approximately 300 hams populating it. Apparently this concentration of hams attracted the FCC to monitor ZDI since in the past few weeks there have been several citations handed out for improper identification (not signing the call, area, i.e. 76) and out of band operation. The latter was the secondary violation in both cases so far, with Technician class licensees being repeated out of their band segment. At present, the FCC has not replied to the cited amateurs' letters. Each one simply stated they were only transmitting in their assigned band, on 146.61 MHz. Has anything similar happened in other parts of the country? More on this next time.

Information about the rest of the West Coast has been non-existent so far, and contributions would be welcomed. Please mail them to Bob Greenberg, 16705 Dalton Ave., Gardena, CA 90247.

Circle June 10th and 11th on your calendar. The Atlanta Amateur Radio Club will hold its annual hamfest on the Mall at the Lenox Square Shopping Center. A banquet will be held Saturday night, June 10th. Main prizes include your choice of a Drake TR-4 transceiver with AC Supply or a RCA Home Stereo Center. A Regency HR-2A will also be given along with other fine prizes. Experts on Teletype, FM, DX and many other subjects will be present. For further information contact W4JM, James Gundry, 2498 Echo Drive, N.E., Atlanta, Georgia, 30345.

* * *

The Tri-State Amateur Radio Association will have its 10th annual hamfest at Camden Park, Huntington, West Virginia, June 4, 1972 from 11 A.M. to 4 P.M. Activities: CW Contest, QSL bulletin board, flea market, prizes for the oldest ham, the youngest ham, and the "fartherest-away" ham. Drawings for the major prizes will be at 4 P.M. featuring Drake TR4 and Drake TR22. You do not have to be present to win major prizes. Tickets are $1.25 each or 5 for $5.00, available from Tri-State Amateur Radio Association, P.O. Box 1295, Huntington, West Virginia 25715.

* * *

The 1972 Jackson Amateur Radio Club hamfest will be held July 29 and 30, 1972. All events will be held inside the Heidelburg Hotel in downtown Jackson MS. The banquet begins at 7:30 P.M. on Sunday, July 29. The price will be $6 per person. The hamfest begins at 8:30 A.M. Sunday, July 30, in the Victory Room. A TEMPO I with ac supply is the first prize. Write to Charles Rogers WA6FII, P.O. Box 8371, Jackson MS 39204 for more information.

* * *

MASSACHUSETTS AMATEUR RADIO WEEK

Operating times are from 0001 GMT June 11 to 2400 GMT on June 17. Massachusetts amateurs must work 16 other Mass. amateurs. The rest of New England State amateurs must work 8 Mass. amateurs. All other amateurs in the U.S. must work 5 Mass. amateurs. DX, including KL & KH must work 2 Mass. amateurs. Any band and mode may be used. All stations participating will exchange signal report, County, and State. Logs must show date, time, and frequency of contact. Applicants must include a No. 10 size (business size) self-addressed stamped envelope (DX enclose one IRC) with application which must be received no later than July 31, 1972. Submit applications to William Holliday, WA1EZA, 22 Trudy Terrace, Canton MA 02021.

The Music City Hamfest will be presented by the Nashville (TN) ARC June 18 (Father's Day) at Lock Two Park, two miles north of Opryland USA. Flea market, refreshments and more. Prize drawing will be held at 1:30 P.M. Talk-in call is K4CPO on 75m and FM 146.94. For more information write Music City Hamfest, P.O. Box 8085, Nashville TN 37207.

* * *

The Ninth Annual Penn - Central Hamfest will be held by the Milton and Williamsport clubs on Sunday, June 4th, starting at 12:00 noon at the Union Township Volunteer Fire Grounds on Route 15 in Winfield PA. Bring your own lunch or use the snack bar. There are indoor and outdoor facilities for auction, contest, and swapping. Gate registration is $2.50 (XYL and children free) and parking is free. Talk-in frequencies: 3940, 50.4, 146.940 2 meter FM. For more information, write to Paul Mitch W3LXN, RD 2, Milton PA 17847.

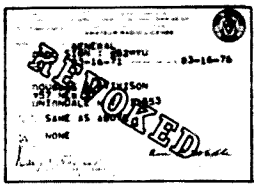
* * *

AKRON, OHIO – The Goodyear Amateur Radio Club will hold its 5th Annual Hamfest Picnic on June 18 at Goodyear Wingfoot Lake Park east of Akron, 1 mile west of Suffield, Ohio on County Rd 87 near Ohio Rte 43 Entertainment, swap-and-shop, prize awards, and good fellowship. Refreshments, displays, huge flea market. Hours: 10 A.M. to 6 P.M. Family admission $2 prepaid, $2.50 at gate. For details, tickets and map write Eugene J. Cooke K8ORL, 3079 Rosebay Blvd., Norton OH 44203.

* * *

The Kansas Nebraska Radio Club will hold its annual hamfest on August 6 at the Moose Club at Concordia, Kansas. Registration will start at 0900. All amateurs are welcome.

WITH THE FCC



The following FCC Bulletin appeared in Florida Skip.

Federal Communications Commission
Field Engineering Bureau
Bulletin

"Manufacturers of audio devices for home use do not design such equipment to operate in the presence of strong radio signals from nearby radio or shortwave stations. Strong radio signals which cause interference to audio devices require that special treatment be given to the audio device receiving the interference. The Commission cannot give any protection to audio devices from interfering signals. The only 'cure' is by treatment of the audio device receiving the interference.

"You should, therefore, contact the dealer or manufacturer of your audio device (or telephone company for telephone interference) for assistance. The state of the electronics art is such that it is possible to manufacture 'custom built' audio devices; that is, to install in the complete shielding and special circuits to reject nearly all types of unwanted signals. Cost of such special design and circuitry would necessitate an increase in the price of the devices.

"Perhaps less than one percent of the total number audio devices in operation todaywill ever be located near enough to any kind of radio station so that the device would respond to undesired radio signals, which it is not designed to receive when in the strong field of a nearby station. If it does, it needs additional filtering or shielding, or both. Manufacturers believe it unfair to burden an entire population with the additional cost of special circuits and design inasmuch as the number of devices affected is small. Therefore, in the less than one percent of the instances where interference is caused by insufficient rejection of strong unwanted signals by the devices, many manufacturers, dealers and servicemen have worked out procedures and processes for interference elimination in such specific cases. The statement of a salesman or dealer that he sells a good quality device, is not enough. Persons receiving interference must fully recognize the situation involved. The audio device may be an excellent one in performing the task it was designed to do. Regardless of the quality of the device, special treatment of it for rejection of strong unwanted signals is essential in some localities.

"RF interference to transistorized audio amplifiers can be eliminated in most cases by connecting capacitors or both capacitors and RF chokes directly from base to ground of the input transistor. If the audio amplifier is part of a stereo system, then this has to be done on both channels. In interference cases of this nature the volume control is in the input circuit, consequently, it has no effect on the RF interference."

ERRATUM

Mr. A Prose Walker has advised us that several of the figures in his speech (reported last month on pages 85 through 89) were incorrect. On page 86, the path losses should have been approximately 176 dB at 435 MHz and 166 dB at 146 MHz. Thus the system in the example would have less capacity and/or signal to noise ratio than indicated. However, various combinations of ground to satellite equipment characteristics can be assumed, each giving different capabilities for an overall system design. Needless to say, the example used was not intended to be used in a hardware proposal for a system.

HOT GEAR

Collins 62S1 transverter, S/N 10728, stolen from the Michigan State University ARC on March 22. Contact Electrical Engineering Dept., MSU, East Lansing, MI, or MSU Dept. of Public Safety (517-355-2221).

WRL Duo-Bander 84 S/N 6010AT302 stolen from parked car in Portland OR on Feb. 15, 1972. Gerald Dimmitt WA6FCY–WA7MMD, 710 East Ave. K*8, Lancaster CA 93534.

List from Past Issues:

Mfr., Model, Ser. No.	Owner	Issue
Halli, SR46A, No.446100	WA1EMU	9/71
Reg., HR-2, No.04-03505	WA5BNM	11/71
Sonar, FM3601, No.1003	WB2ARM	11/71
Coll., 75A4, No.804	WØMGI	12/71
GE, Portable, No.1041218	K2AOQ	1/72
Coll., 75SE-B, No.15640	Col.St.U.	1/72
Coll, 21S3, No.12000	Col.St.U.	1/72
Coll., 516F1,No.1649	Col.St.U.	1/72
Simp. Mod-A, No.35457	W2PWG	1/72
SBE SB-33 No.103906	WA5JGU	2/72
Heath HW22A No.907-1835	W1BDX	2/72
Nat'l HR050 No.280019	WA5DQF	2/72
Halli., SR160 No.416000-108039	K9YVA	2/72
Drake TR3 No.3858	WA9EYL	2/72
Coll., KWM2A No 13815	ARRL HQ M. Godwin	2/72
Coll., 312B4 No.59920		
Coll., 30L1 No. 40084		
Coll. MPL No. 44507		
Coll. MM1 (mob. mike)		
Misco minispkr.	Sgt. Hopkins Wilm. DE Police	2/72
Swan SW174 No. 416-5	WØAXT	2/72
Reg. HR2A No.04-05896	K4GBL	2/72
HR2A, No.04-6208	W8FXX/5	3/72
Heath SB102,No.132-128107	W.Singer Woodbridge VA 703,491-2257	3/72
Yaesu FT-101 No. 107036	WA2YSW	4/72
Standard 2m FM No. 102703	W6NPV	4/72
Drake ML2 No. 20189	WB2LLR	4/72
Standard SRC-806M No. 009210	K1TLP	5/72
Aerotone 6M 355LT, No. 685064	RR Police Grd.Ctrl.Trml. NYC	5/72
Standard SRC-806M, No. 102703	C. Mathias	5/72
Lafayette HA-410 No. 009210	WA2KDG	5/72



EDITORIAL BY WAYNE GREEN

DAYTON!

The Hamvention is hands down the biggest ham event of the year. The only real criticism I can make of it is that it should run for two or three days instead of one single day. There is just too much to do.

If you have any interest in building or buying equipment then you can't pass up the flea market. I would estimate that there were a couple of hundred "booths" set up in the parking lot with enormous piles of ham gear . . . from the most sophisticated slow scan and FM gear right on back to World War I military surplus. Tons upon tons of parts . . . equipment . . . stuff. They had more there than the Allied catalog. I spent an hour browsing through the place and wished I had several more hours and a pickup truck . . . plus unlimited cash.

The manufacturers' exhibits were lavish. There was no way to see them in less than a couple of hours . . . and to do that you would have to skip a lot of interesting things. Many new items were being shown there for the first time. Tom Litty K6RAD had a TPL Communications booth and showed his new 220 MHz transceiver which should be out in July in quantity, selling for about $220. He also had his superb line of solid state amplifiers for 146 MHz, 220 MHz and 450 MHz. These items are being merchandised by Henry Radio under the name of Tempo and are built in California.

Ed Clegg was there with his new 220 transceiver, also due out in July in production runs. FMers also looked longingly at the 27A Clegg unit on display. Drake surprised everyone with their new 220 transceiver, made by the same folks who make the Marker Luxury 2m rig.

There were so many new things that there is no way to remember all of them. J&R Electronics were showing their new slow scan monitor . . . should be a winner. Robot was wowing them with their slow scan gear and showing what can be done. Slow scan was really big at Dayton . . . it looked like about 500 active slow scanners at the forum to me . . . and the orders for our upcoming slow scan book poured in.

The forums ran all day long and I wanted to see and hear every one of them . . . but had to miss virtually all since I had to stop by the 73 booth now and then . . . see the other exhibits . . . try and sell a few ads (almost impossible in the hubbub) . . . and put in a few words for several of the forums when I managed to get to them at an appropriate time. I tried to make the Midcars forum, but got there early and late . . . I wanted to try and let them know that I intended to convince repeater groups to set up a down link to 7255 kHz for emergencies so the two meter repeaters could work 7255 simplex when wider area emergency coverage is needed. I just got one of the little Justin sideband transceivers and hope to have a chance to set it up with our repeater (WA1KGO) for this service, operated by a 2300 Hz tone burst to make the down link tie in.

I had my slides of Jordan along, but didn't see myself on the program so I wasn't sure when to drop in on the DX forum . . . they seemed busy when I went by . . . and I missed showing them. Oh well, I'll have a new set of slides of Jordan in a few weeks My others are two years old now. Time flies.

Some of the companies that didn't turn up as exhibitors were interesting for their absence. There has been some mystery about whether Rpt magazine was still in business or not. The last issue I've seen or heard about was February. They didn't show at Dayton . . . but a good friend of mine did show there sporting a disk jockey magazine just being started by the erstwhile publisher of Rpt . . . and he said that Rpt was on ice. I think I mentioned that special interest ham magazines have a way of never making it.

There was no Dycomm exhibit either! When you consider that this was the biggest FM event in the country this seems very significant. Incidentally, 73 will no longer accept advertising from Dycomm.

Judging from the number of Motorola HT-220's I saw at Dayton, the Motorola company must have added at least one more assembly line. It looked like thousands of the little beasties, though it probably wasn't any more than 500 or so. They were in pockets and hanging from belts everywhere. The Standard 146 is beginning to show now too . . . I did see dozens of them. They're just getting started. Oh, by the way, watch out for the Standard 145 . . . this is the Japanese model and is startlingly different from the 146 . . . different transmitter in particular. It uses 12 MHz crystals, in case anyone tries to fool you. The 146 uses 8 MHz crystals, like the 826. We had a 145 here at 73 for a few days and were unable to tweak it on channel because the rig had so many outputs that the counter couldn't decide which was the one to count. I don't see any way that unit can meet FCC specifications. I guess they don't care about spurious output that is almost as strong as the intended output in Japan. We care. Beware.

MIDWEST FM SYMPOSIUM

On the evening before the Dayton Hamvention a special FM Symposium was held at the Imperial Motel. Though there was little time to pass the word about the meeting, representatives of 46 midwestern repeaters were present, along with about 300 FMers.

The main topic for the evening was the plans for organizing a serious effort to save the 220 MHz band from the EIA and a handful of greedy manufacturers. The main approach to holding the band is to use it . . . "USE IT OR LOSE IT."

This Symposium was a follow-up on the one in Shrewbury (Mass.) in February where representatives of over 50 eastern repeater associations agreed to set up 220 MHz repeaters as soon as practically possible. Within days of that meeting the first 220 repeaters were set up and operating, coordinated by F2BO/W1, K4GGI/1 and WA1KEC the committee for eastern U.S. coordination.

The repeater representatives at Dayton also agreed 100% to get on 220 as soon as possible. This leaves only the southwestern and western parts of the country still not committed to going 220 immediately. Hopefully the repeater groups in these areas will get together at Fresno in June and put their repeaters on the line to back the project to save 220. California needs 220 more than any other part of the country, so perhaps this will be an added inducement.

Considerable equipment is coming along for 220. Ed Clegg showed his new 220 transceiver at the Symposium. This unit has a great many interesting features and should be in production by July and sell for under $300.

Bob Booth W3PS, counsel for the ARRL, was present and spoke about the need for cooperation between all groups if the band is to be saved. Both ARRL and 73 are working for the

same goals and working in the same directions . . . now if only CQ and Ham Radio would lend a hand!

The Midwestern Symposium was certainly fun . . . and a success.

73 PROTECTS YOU

Some of the FM units that we have checked out have not been written up in 73 . . . and this is no accident. They just don't pass muster. When we run into rigs that are not up to snuff we not only refuse to run articles on them, but we generally refuse to accept ads for them, unless the problems are marginal. You may be sure that when we do write about a rig that we have checked it and we like it.

A reader recently wrote in regarding one of the transceivers that 73 has NOT advertised. *"Have had much trouble. The receiver desensed 100% by nearby low power transmitter. Factory installed trap cured that problem. Intermod tremendous. Local taxi and sheriff's repeater cause full scale deflection of signal strength meter, local 2m repeater desenses receiver. Sensitivity changes with vibration. Squelch much too touchy; meter impossible to read at night in the car; insufficient audio for mobile operation; channel numbers difficult to read; cover screws strip easily; etc."* This chap has a Sonar 2301 that he likes and a Standard 146 he thinks is "great." From all those desensing problems you might expect this chap to be in New York City . . . he is in Nevada.

WHOM TO WRITE

If you are uptight over the idea of turning our desperately needed 220 MHz band into a screaming mess of CBers . . . if I may put the case to you factually and unemotionally . . . then why not drop a line giving your thoughts to one or two of the members of the Electronics Industries Association Executive Commitee?

You might write to the Chairman of the Executive Committee, Richard Horner, E. F. Johnson Company, Waseca MN 56093. Or you might get in touch with Andy Andros, the president of Hy-Gain Electronics. Lincoln NB68501. If they can't stop the drive to take away this band, at least they can pull their company out of the EIA and stop furnishing the money which is being used to lobby for it in Washington.

CONTROVERSIAL FM'ER

The other day Carl Lindeman W1MLM, NBC's VP of sports, was flying across the country, TR-22 in hand, talking through various repeaters. With him was controversial sportswriter Howard Cosell. Howard's interest in the proceedings quickly rose to where he spent most of the trip arguing heatedly with amateur radio sports fans as they passed over them.

I can just see a dozen or so amateurs across the country rushing into the kitchen and telling their wives . . . "Hey, I just talked with Howard Cosell!" And I know what the wives said, too. "Who's he?" Fellows, I know just how it feels. A few weeks ago King Hussein called me on 20m and we talked for a while. After I signed I was busting to tell someone about it and at that particular time the baby sitter arrived so I casually mentioned to her that I had just finished talking with King Hussein. She had never heard of him . . . or Jordan. I'm not sure she has ever heard of Israel.

K2ORS NOMINATED!

Jean Sheperd K2ORS, frequently heard through the repeaters around New York . . . particularly WA2SUR . . . via his Tempo FMP transceiver, and heard nightly through WOR, has been nominated for an Emmy award this year. Jean Shepherd and Jane Fonda were the nominees for the Most Interesting New Performer on television for 1971. If you have any friends whose vote counts toward the Emmy, nudge them re Shep.

Shep was the feature speaker at the FM Symposium in Shrewsbury in February. The array of walkie talkies there got to him, and he has been an active FMer ever since, usually talking from his office high up in the WOR building on Broadway.

MORE TWO METER FM CHANNELS

The FCC does not have any intention of giving us the green light for repeating Techs above 147 MHz. Though their rules are quite explicit and it would be exceedingly difficult to interpret them as prohibiting a repeater from retransmitting Techs above 147, it is obviously easier to avoid a fight than to go after one . . . so most repeaters have been avoiding the 147 MHz range.

The 146–147 segment is FULL in many parts of the country and the pressure is mounting for more FM repeater channels. Where to go? Once gear is available in quantity for 220 MHz that is the obvious band for further repeater expansion . . . but it will be quite a while before the manufacturers are able to supply us with enough 220 gear to make that band really useful for everyone. In the meantime we must have more FM channels . . . and they must be on two meters. The answer is obvious . . . they will have to come out of the 145–146 MHz segment.

But won't we get into a big fight with the AM ops down there? We started in above 146 MHz because the AMers didn't use that part of the band. If we start moving down aren't we liable to get a big war started? I doubt it.

I've been tuning the lower two MHz of the band for some months now and I have so far heard exactly one (1) AM station on the 2m band from up around the New Hampshire area. One weekend I tuned the band in New York and all I heard there was one (1) AM station all weekend! Either I managed to listen at all the wrong times and missed hearing all the AM activity or else all those chaps have moved up into the FM band. I suspect the latter. Who would stick with AM on 2m when FM is so very much better?

If my survey is correct, then we do have some channels available for FM which will not inconvenience any other ops. I suggest that instead of using those confounded splinter channels in the 146 range that we start using standard channels in the 145 segment.

If we start easily, opening up about six FM repeater channels, there should be a minimum of bloodshed. I suggest that the repeater input be high and the output low, with the following channels used.

145.71 - 145.11	145.80 - 145.20
145.74 - 145.14	145.83 - 145.23
145.77 - 145.17	145.86 - 145.26

This system will leave the bottom 100 kHz of the band open for AM operation . . . sideband, whatever. It will also leave the surplus crystal channel of 145.35 open . . . as well as the 145.9 146.0 for satellite input.

I realize that this is probably impractical in Los Angeles, but perhaps it will work elsewhere. Any comments? Any takers?

600 kHz Uber Alles

The universal change in the eastern part of the country to 600 kHz repeater spacing was not accomplished without some difficulties. The wonder of it was that the battles were so few and far between.

Some of the skirmishes have recently been settled. For instance there was the little matter of WA1KFX on Mt. Snow on 31–91. This repeater, operated by Gordon Pugh W2GHR, had been on 31–88 for some years and then suddenly appeared on 31–91 early this spring . . . not long after the Mt. Greylock repeater shifted from 04–91 to 31–91. Thus there were two closely spaced and far-reaching repeaters both on 31–91. The result was an incredible mess and the hardest of hard feelings.

Many repeater people have been severely critical of Pugh for jamming

(continued on page 10)

W2NSD/1 *continued*

the Greylock repeater and have been openly hostile to the attempts of Pugh to form a repeater organization in view of his lack of cooperation on 31–91. Pugh was the instigator of the North East Repeater Association and became its first president.

Apparently the pressures grew to where something had to give . . . and Pugh gave. WA1KFX would go off 31–91 and would move to some other open channel, possibly 01–61, since that seemed open for that area.

It should be pointed out that WA1KFX, though it has been on the air for several years, is remotely enough located in Vermont so it has seen little use. It has been off the air entirely for the last few months, so the sudden appearance on 31–91 was quite a shock to the K1FFK groups, which number close to 200.

KFX is reachable in April only on skis and the first reports are that Pugh did follow through with his agreement to turn off the repeater, but that he broke a leg on his way back down the mountain. The Greylock group wishes him a speedy recovery.

Another hassle was over 146.76 around the Long Island–Connecticut area, with WA2UZE on 16–76 and Bridgeport WA1KGK on 22–76. Power and feelings had escalated about evenly and the grievances were many and strong . . . UZE was there first by about ten years . . . KGK had more users and a wider range . . . and so it went. The solution came when the two principles finally sat down at the bargaining table and worked it out. UZE would stay on 76 . . . KGK would move to 10–70 . . . the UZE crew would guarantee to move heaven and earth to get the RTTY ops on Long Island to change from 70 to 146.55 as an RTTY simplex channel . . . and this is not simple because it means coming up against Byron Kretzman W2JTP and occupying his "private" channel. The Staten Island group agreed to move WA2YZZ off 70 RTTY to make room for KGK . . . and so it went. K1ABR in Rhode Island will probably move from 10–70 to 01–61, thus giving KGK more elbow room.

One other sore point was solved too, with the WA3BKO Philadelphia group agreeing to get the higher powered base stations to stop using 28 and use the 16–76 Philly machine, thus permitting WA2YYQ on Staten Island to move from 25–88 to 28–88.

Things are really falling into place for universal eastern 600 kHz spacing.

. . . *Wayne*

Military Affiliate Radio System

New Chief MARS Army, A3ZLH, is off from the starting gate faster than a speeding bullet! Innovations already announced are plans for updating the weekly WAR Broadcasts, a new SIG 439-2 Communications Manual and new carpets for the office! Chee! Southern New England has a new RATT net on 4035 kHz at 1901Z Sundays. A3NFS won the First Army Commander's Annual MARS Trophy. A1VFB is new Maine Army Mars Director. MARS Director. A very well-attended Spring meeting was held at Natick, Mass. As most such meetings, it included a "happy hour." Fifth Army MARS called it by a different name at their four-state convention in Fort Leavenworth, Kansas – "Attitude Adjustment Hour!"

Delaware MARS held their semi-annual meeting in Dover, complete with Crab Imperial, Crepes Suzette and a Swap-Shop. Their first two meter repeater should be in operation soon (in 148.01, out 143.99– as are most MARS Army installations). A *"did you know"* item: Office of Civil Defense has hired Systems Development Corp. to make a study of RACES. Wonder whom they will ask for opinions? Armed Forces Day cross-band operation was greater than ever, with NSS, NPG, AIR and WAR reporting hundreds of contacts with hams throughout the world. Your QSL cards and certificates will be mailed soon.

Air Force MARS is undergoing a geographical reorganization. Details have not been officially announced, but a reliable source informs us that there will be three major divisions, each being divided into several smaller groups of states. The new Air Force MARS manual is being distributed and one important change is noted: AF stations are now allowed to cross state lines with VHF repeaters as long as operation is within the same region.

Third Army's Fifteenth Annual MARS Conference was attended by more than 700 members and guests! They too had an "Attitude Adjustment Hour," a portion of the activities which can only increase in popularity as time progresses. Congratulations to Director Hal Mulkey for the finest conference ever. Assistant Chief MARS Army Joe Ziglinski was a welcome guest. Congratulations to AD4DQQ, honored at the Conference as Third Army's Operator of the month. In passing, Third Army's oldest VHF repeater, on Brasstown Bald is now in its *13th year!* This repeater was utilized to bring immediate help during a recent tragic occurrence. A camper-trailer went through a guard rail into Lake Hartwell in South Carolina. A4AZT, witnessing the accident, called through the repeater into Atlanta reaching AA4YBT, who alerted the South Carolina Highway Patrol. Although help arrived within a matter of minutes, it was too late.

Fifth Army Director Roland Belk has been on the road for months attending State meetings throughout the area. One of the largest was the Texas meeting at San Antonio. Still upcoming: Iowa, 3–4 June, Minnesota 8–9 July and Illinois on 31 July–1 August. ADØNIC was named Fifth Army Operator of the month, and AA5WHN is new Training Officer of Fifth Army. New Manual REG. 105-4, is being distributed to members.

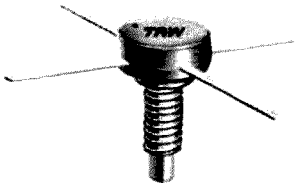
The Texas RATT Net has gone to 170 Hz shift – a growing national trend. If you have been using WBR/70, Miami WX, to adjust your printer, etc., don't be surprised when they go to 100 wpm on 1 July. Louisiana has a new VHF emergency communication plan, under which the 2 and 6 meter MARS repeaters are tied together to cover a large part of their area. Meetings in that state were held in Shreveport and Alexandria. Missouri State MARS meeting is being held in Lebanon, with VHF repeaters high on the agenda. A new Missouri repeater is in operation in the Cape Giradeau area – your editor accesses it often, but perhaps they don't answer AR's.

AA6TOV has been appointed Director of Research & Development, Southern California Army MARS. That group's very fine Monthly Signal, edited by AA6GJY, has just finished a fine series on the Apollo program, and is now featuring a first-person account of the sinking of the USS Milwaukee in 1917, a story told by AA6LJ. In addition to the usual 148.01–143.99 repeaters, the Southern California group has repeaters on 143.415 in, 148.650 out. Also, while we are fooling around with those 2 meter frequencies, they already have nets going on 432 and 1296 MHz! The Arizona MARS meeting will be held in Tucson in conjunction with the Old Pueblo Radio Club Hamfest.

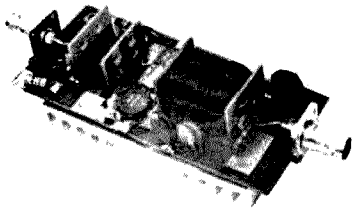
This column is designed to keep you informed of matters MARS. If you have information that should be included, or if you would like to become a member of one of the three MARS programs, contact Harry Simpson, A4SCF, P.O. Box 27015, Memphis TN 38127. ZKJ – which is MARS-ese for QRT.

NEW PRODUCTS

NEW LINEAR TRANSISTOR

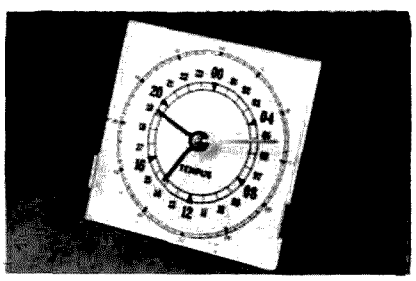


TRW Semiconductors has developed a new transistor that will have wide-reaching effect upon us all. Their PT5740 series can be driven with less than a watt for outputs of over twenty watts at twelve volts. This is significant for transistor power amplifiers that can be used in your car with flea power drivers. Four of them can be driven to over 100 watts output which is perfect for driving most tube kilowatt amplifiers currently on the market. QRPPers can easily go QRP or QRO with a single transistor.



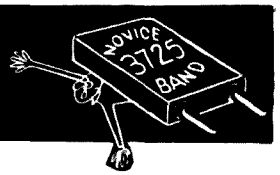
There are simple circuits that can be duplicated to make broadband power amplifiers that will amplify a one watt signal to over a hundred watts output at 14 MHz, all from a 12.5V dc source, not 28 volts as is required on several other similar circuits. As the amplifier is broadband, no tuning is necessary from 80 through 10 meters with a 50Ω load. TRW has the transistors available, and their application notes give all the information needed to make the power amplifiers. Write to *TRW Semiconductors, 14520 Aviation Blvd., Lawndale CA 90260* and ask for CT-122-71 and CT-113-71.

CORDLESS 24 HOUR CLOCK



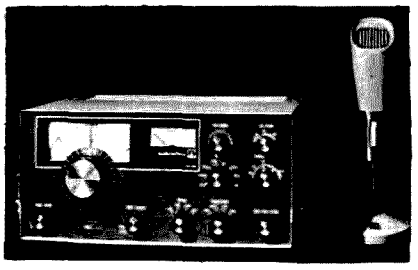
Traffic men and DXers who need to watch the time in two time zones will want to buy this 24 hour clock with a second hour hand for keeping time in local time, Greenwich time, EST, EDT, or any other time. The beauty of this clock is that it will run for almost two years on a standard C-size flashlight battery. This handsome clock will look beautiful in your shack and it will help you meet your nets and skeds. It is only $29.50 from *Tempus Instruments, Villa Italia Center Suite 594, 7200 W. Alameda Ave., Denver CO 80226.*

NOVICE



Alaska is a rare state for most people, not just Novices. In fact there are only about 1,200 hams in Alaska, which is about 0.4% of the total number of hams in the entire U.S. Although it looks hopeless for the Novice to find an Alaskan ham, much less an Alaskan Novice ham, there is a way. On most week nights at about 0700 GMT, there is a Novice Net that is based in Alaska on 21.225 MHz. Active stations in the net include WL7HH), WL7HET, and WL7HJR. Although it may seem unlikely that you might get in to Alaska at that hour, keep listening. This is the kind of activity for which many top DXers look. Tune the frequency at the time that the station is normally on, and keep doing this until the moment comes that you work the rare one. He may be booming in due to freak conditions or he may be very weak in the noise. But keep trying. He's in there waiting for you.

NEW SSB/CW XCVR



Hallicrafters has a new sideband transceiver that deserves investigation if you're looking for a new or second rig. The FPM-300 features all solid-state construction with only two tubes and modular construction throughout. The rig runs a cool 250 watts PEP or 180 watts CW. You will sound much stronger on sideband, however, because there is an IC speech compressor for emphasizing audio punch. Full coverage of all bands and built-in ac and dc power supplies complement the rig for a great fixed or mobile signal. *Hallicrafters Co., 600 Hicks Rd., Rolling Meadows IL 60008.*

AMSAT ACTIVITIES

Mike Frye WB8LBP
640 Dauville Dr.
Dayton OH 45429

The Radio Amateur Satellite Corporation (AMSAT) was formed in 1969 to provide amateur satellites and space experiments for the amateur service. Membership currently numbers 460, including over 40 member societies, and is worldwide with amateurs from some thirty countries represented.

AMSAT is currently active in preparing for the launch of AMSAT-OSCAR-C (A-O-C), scheduled to go up in July, 1972. A-O-C will feature a 24 channel Morse code telemetry system developed by W5CAY; the 432–146 MHz ten watt linear translator developed by DJ4ZC and DJ5KQ in Marburg, Germany; the two-ten meter linear translator built by W4RUD, WA4DGU, and K3JTE, the 35 function command system provided by WAI-Project Australis, and the instrumentation converter provided by W3GEY, A-O-C project manager. CODESTORE, a Morse message storage unit was developed for storing emergency messages, operational information on the satellite and orbital information for repeated transmission to the ground over the satellite's telemetry systems.

When A-O-C is ready for launching it will ride piggyback on NASA's ITO S-D meteorological satellite into a planned 1500 km polar orbit.

AMSAT has also submitted a proposal to NASA to provide for amateur experiments aboard the ATS-G Applications Technology Satellite scheduled for 1975. The space would be put to good use with a SYNCART (*SYN*Chronous *A*mateur *R*adio *T*ranslator) experiment. AMSAT will provide NASA with a 146–435 MHz 20 watt linear translator for integration into the ATS-G package. The satellite will be placed in a geostationary (synchronous) orbit. It will contain a 30 foot parabolic reflector which is available for the SYNCART experiment. This will enable amateurs for the first time to use a synchronous satellite on a more or less regular basis with modest amateur equipment.

The SYNCART package is designed for emergency communcations, educational training and experiments with small terminal multiple-access communications.

AMSAT members at the NASA Goddard Space flight center and many other manned flight centers have been assisting with these projects. Dr. Owen Garriott, one of the astronauts in training for SKYLAB, has indicated his support. Dr. Garriott happens to be W5LFL and a member of AMSAT.

The 50 MHz Band

As of this writing there has been no further word on the VP5RS DXpedition planned by W4GDS, but knowing Bob's ability to get things done it would be safe to assume that everything will come off as scheduled.

Webster defines a hobby as "a pursuit outside one's regular occupation enjoyed for relaxation." Public service aspects aside, amateur radio is supposed to be fun. It therefore behooves each of us to avoid doing things which deprive others of their pleasure. Do you call a rare or DX station every time he stops transmitting? Do you inquire if the frequency is in use before calling CQ or tuning up? Do you own and USE a dummy load, even on VHF? Do you make transmissions so long the band folds before you complete one schange? Do you call CQ so long the prospective contact gets tired of waiting and looks elsewhere? We have all experienced signals 20, 30 or 40 kHz wide obliterating a goodly segment of the band. A malfunction can happen to anyone, but all too often the cause is Fred talking to Harvey down the block with his Band Burner VI (or the matching linear) cranked into saturation . . . just like the last time the band was open. QRM from other stations in QSO and tuning up, etc., has become as common as on the lower bands. But it need not be so. Rarely, even during the widest openings, does one hear activity above 50.2. With 4 MHz available, doesn't it seem a bit ridiculous to congregate in the first 50 kHz? Would it not be reasonable to assume that all would profit if we were to make better use of the band during openings?

A report has been received to the effect that WA5HNK worked CE4CP on March 25th. This to my knowledge is the first Chilean contact since Urly, CE3QG, was active several years ago. XE1PY remains active with several stations reporting contacts during the past month. Bob WAØTXV, is looking for scatter and/or groundwave contacts on Sunday mornings from 0500 to 0800 CST.

The comment in the March issue relative to the lack of activity in Kentucky really stirred up a hornets' nest. Tony WA4JQS, informs us that he and Ken WB4UQC, are active from Somerset. Both are working on linears with 3–500Zs. This industrious pair will be operating from a fire tower at 1590 ft above sea level during the VHF contest and will be happy to make schedules on 3960 kHz. Also add Hamp WB4SBU and Don WA4VIR of Jeff Town and Fort Campbell to the list of active stations in Kentucky.

SSTV SCENE

Slow scan activity has started to pick up on ten meters with most of the activity centered on 28.680 MHz Saturday mornings and Sunday afternoon. A fair amount of activity from Europe and Africa there also.

A few months ago I noticed Denson Electronics' large ad in 73. So I checked into them and found a real gold mine of fast and slow scan TV goodies. Zoom lens, turrents, projection TV systems and much more. The video tape recorders really caught my eye. Some were under $400! What possibilities! Video tape those ATV QSO's, or make up programs to feed when you're not using the camera. Coupled with an on-off timer and TV, you could work up a system to tape favorite TV programs for later viewing. Our day of dreams is rapidly approaching.

Those suffering TVI would do well to try the bandpass filter design by WA5SWD/6 described in the January 1970 issue of 73. Several of these are in use in this area and are doing a good job of reducing TVI on the local channel 2, the callsign of which is a very appropriate KTVI.

Doc WA7FLB, reports a very quiet winter, which is probably just as well. Doc has had antenna difficulties but promises to be back in full operation shortly. K9SDF is recovering from double hip surgery and expects to be out of the hospital and on hand for all of the spring openings. Very good planning, Gabe! Larry Phant WØRVF, works the nightshift on 6 meters, seldom getting on before midnight. You late night types would do well to turn your beams in the general direction of St. Louis in the early morning hours.

It seems that not many 6 meter hams are aware that many TV manufacturers will supply high pass filters at no charge or for a small handling charge. I would be pleased to send a copy of a list of manufacturers' addresses collected over a period of years to anyone sending an SASE to my home address. This list is not complete in that many "house" and imported brands are not included, but it does cover a good cross-section of the more popular brands. Perhaps I am leaving myself open for more than I can handle, but I will also offer assistance to anyone who needs help in getting on the air, curing TVI, or any other problem, as long as it pertains to 50 MHz operation. I can't guarantee anything other than a sincere effort. See you on 6.

Bill Turner WAØABI
5 Chestnut Court
St. Peters MO 63376



I have a very interesting picture for the column this month. This was recorded by W7ABW, and photographed (and described to me) by WB8BQT about two years ago. Notice first the skewed lines running from the bottom left to the top right of the picture. Here the playback recorder was running slightly faster than the recording tape recorder, thus the lines "lean" toward the right. If the playback recorder had been slower than the recording recorder, the lines would be skewed from the top right to the bottom left. If the two tape recorders were running at the same speed the lines would be vertical, and not noticeable, except for four very slight "humps" at the very top of the picture. It is those four "humps" (60 cycles divided by four) that makes the skewed lines. The picture starts erratically on the right top. A perfect SSTV picture starts the first line two thirds of the way across the top. (The blank period is the vertical re-trace.) Notice the texture of the hair, and the white of the collar this is evidence of a high quality gray scale. There is a slight light reflection in the center of the left eye, showing the definition a 120 line slow scan picture is capable of producing. Now remember, a certain amount of quality is lost each time a picture is reproduce i, thus the original image on the screen was better than the photo and the photo better than the magazine picture. So the magazine picture is third rate to the original viewed on the screen.

Robot Research is busy these days. Their SSTV directory is in the works and should be available very soon. If you haven't sent them a post card yet telling of your SSTV activity better do so right away or you may get left out. They are also publishing a short SSTV newsletter which is usually available from authorized distributors. It is refreshing to see a company interested in just more than selling their product, and Robot is as gung-ho on slow scan as we are.

That fellow with the high country total on SSTV is Gene W8YEK, who has 44 countries confirmed. Close behind him is Eddie W4MS, with 40, and WAC/SSTV. W8UUS and a couple

Microwaves

Those amateurs working at the higher microwave frequencies will be glad to know that the National Bureau of Standards (Boulder CO) can now measure frequencies on the order of 85 terahertz (or 85,000 GHz) to an accuracy of about ±10 parts per billion. The apparatus used as a mixer for these measurements uses a microscopic version of the cat-whisker diode. Shades of 1923!

AT&T has proposed that the land mobile telephone service be moved from 50, 150 and 450 MHz to 850 MHz so that more channels may be accommodated. The FCC has responded by opening a new band from 806 to 881 MHz, to be used exclusively for mobile communications. If this plan is implemented, there is going to be quite a haul of VHF surplus FM gear on the market from people evacuating to the new band. Watch this column for more info, or see March 72 *Microwaves*.

An added note: Motorola objects to the AT&T plan, and instead asked for another band at 900 MHz; no FCC action on this proposal is known of at this time.

New Microwave Products

Microwave Semiconductor Corp. (MSC) has scooped the bipolar industry again by announcing a 5 watt (output power) device at 4.0 GHz. At $400 apiece, I sincerely doubt you or I will put one on the ham bands soon, but don't forget that the 2N3866 was over $100 just ten or so years ago. Base and emitter linewidths of one micron allow minimal parasitic reactance while still providing maximum power gain at 4 GHz for the MSC 4005.

Last month's mention of arsenic transistors has led some amateurs to comment that 15 GHz is a pretty high frequency to be fooling around with transistors. While I must admit that 15 GHz is the state-of-the-art as far as bipolar transistors are concerned, I feel I must mention that there are commercially available FET's that have cutoff frequencies (F_T) of 40 GHz. Now, that's really *moving!*

Jim Weir WB6BHI
P.O. Box 23233
San Diego CA 92123

of others have WAC on SSTV also, and Bill XW8AX has left Laos and returned to the U.S. But alas . . . there are some 4X4's on SSTV hanging around 14.230. . . .

Well, summer is here, and may all your hamfests give Robot gear as prizes.

Dave Ingram K4TWJ
Rte. 11, Box 499, Eastwood Vil. 50N, Birmingham AL 35210

LETTERS

ou goons don't ever
bunch of
you ignored my
I insist that you print

KIND WORDS

With so much computer talk now interesting hams – and your interest in various usages of "73," have you ever noticed how evenly this comes out as a binary number: 1001001?

Alexander Stewart W1TD
Camden ME

Haven't noticed.

I have been in the ARRL for the last year but QST just doesn't cut it for me. Not enough articles that are really for a beginner like me, so I've had to go out and buy 73 off the stand. Your "General Class License Study" is a help for my next step which I'm sure is going to come out on the passing side. Keep up the good work. Guys like me need a mag like 73.

Earl Bach WNØAVU
Minneapolis MN

You keep up the good work, Earl. Ham radio needs guys like you.

Please accept my congratulations for your consistent production of a publication that contains useful, authoritative articles. These articles are written so they are easily understood without regard to the complexity of their subject matter.

F. W. Harland
Abington PA

I have enjoyed your magazine for some time now. I find it more interesting than QST. I am interested in your IC applications articles. How about a feature article on SSTV which summarizes the developments to date for someone who knows very little about SSTV.

David A. Bollmann
Bethlehem PA

Coming.

. . .AND A RASBERRY!

Cripes! Just shelled out one buck for your April issue! It's a catalogue not a magazine! You lost a long-standing reader!! WHEN you eliminated the jokes, W1YSD, and W2NSD/1 funny comments and went all FM it was Baaaaa!!! But turning 73 into a catalogue, phooey! I can get *free* catalogues and brochures.

No Block + No Manning + No interest = No ME!!!

Cal Emerson

If you want humor, read CQ. Their April Fool survey article was a laugh and a half.

EUROPEAN TOUR

"Three solid weeks with Wayne Green?" All I can say is *YUK*!!!

D. M. Casselman WAØGSY
Conway Springs KS

Three solid weeks with D. M. Casselman? Double YUK!!!

PLATE PLIGHT

There is so much to say about the April issue I'll try to keep myself down to a few choice words so as not to take too much of your time. This issue was so great that a few of us got together just to sit and praise it last evening! You really hit the top with this issue!

Watch for some fire from Nebraska in the next year or so about license plates: seems the legislature here said anyone who wanted special plates could pay a $50 fee and many people did. Then they saw amateurs with call plates and learned that the hams paid only about $2. People got mad and wrote their congressmen. Now we wait! I like Alaska's system for amateur plates if rumors are correct: $1.00 total cost if vehicle has mobile equipment regularly installed in it. This could encourage some growth in the ranks if nothing else will.

G. Wayne Heck WB9HJM/Ø –NØTUB
7401 South 33 St.
Omaha NB 68147

I want to tell you about a bum deal we are about to get from the Michigan legislature. Michigan amateurs were able to get their call letters on their auto plates for $2.00 over the regular cost of plates. This isn't anything new but what is new is that some group has pushed a bill through the Senate (March 16, 1972) boosting the fee to $25. The bill is Substitute Senate Bill 240, I believe. By chance, one ham (W8AQA Saginaw) found it out and the result is angry muttering all over Michigan. If it can happen here it can happen in other states. We know CB'ers have been stumping for their

(continued overleaf)

call letter plates for some time. This may the the state's way of shutting them up and at the same time stopping complaints of favoring certain groups, but I think it still is a bum deal.

R. Dring K8YQC
1100 E. Hill Rd.
Flint MI 48507

It seems like the license plate issue is up again in different parts of the nation. How have other groups worked to repeal this form of discrimination against hams? Please send information to either/or both of the gentlemen above and send a copy to 73.

Amateurs all over the world must have a quiet chuckle to themselves as they watch the goggle-box and anything to do with radio crops up – for the TV-men ALWAYS goof it! Here in England we get all your "Cops and Robbers" films and I was rather idly watching one recently when the strong arm of the law burst open the door of the baddies' hideout. The local police-inspector looked puzzled at what he saw inside the room, but the know-all FBI agent explained rather airly, "Aha, yes, that's a very high powered marine wireless transmitter."

No wonder the inspector looked puzzled, for the camera zoomed in on a typical Novice setup, complete with DX-40.

When will the film producers learn to consult an amateur?

Douglas Byrne G3KPO
Spalding, England

At our FM Symposium in Shrewsbury, Massachusetts, one ham walked around talking into a Minox camera with toothpick antenna.

DYCOMM DISSECTED

After seeing your "Dycomm Demand" story in the April issue,I thought I would share with you an experience I have had with the good folks at Dycomm.

December 21, 1971, I wrote Jim Penny at Dycomm and indicated our CD group was in the process of installing a repeater and I wanted information on the Dycomm repeater. We had been considering a Motorola unit. Two months passed, we had our money in our hands, but no word from Dycomm.

I called Dycomm the latter part of January, talked to the secretary who answered the phone, explained to her the situation, and she said that Penny was in a conference with everybody else and couldn't be disturbed. She acknowledged receipt of my letter and said that she would have him either call me back or get a letter out to me in the next day's mail. Two weeks later, nothing.

A friend who is the owner of a nearby repeater saw me a week later and I told him of my unsuccessful attempt to buy a repeater from Dycomm (he had ordered a Dycomm machine earlier but had not received it) and he said he would be talking to Penny in a few days and would mention my plight, which he did. He told me that Penny was sorry as hell and had misplaced my letter and would I please by so kind as to drop him another letter, which I did. I sent him a Xerox of the first letter to him with a note at the bottom telling him that I had also called him. *To this date I have not heard from Dycomm.* We have since bought a solid state GE repeater ($700).

I thought you would be interested in how one of your advertisers responds to requests for information. Also I guess you are not the only one who has trouble getting them to read their mail.

Name withheld

No further ads will be accepted from Dycomm for the Repeater Bulletin, 73 Magazine, or any other 73 publications.

ANOTHER CHANCE! OH, WOW!

You are probably wondering why I took so long to renew so I'll tell you. I was considering dropping you because I did not like your sideways format and the fine print was too much strain on my farsighted eyes, and also you did not put your yearly index in the Dec. 1971 issue. What I do like is your construction articles and also you keep me posted on what the other mags do wrong. I get them all.

Please push for more activity on 220 MHz even if it is FM repeaters so we don't lose it. I am a 2 meter AM operator and also some 6 meter SSB. I have also operated on 220 but there wasn't much activity so I shelved it temporarily. I decided to give you another chance so don't disappoint me with any more cockeyed formats.

Joe Murphy WA2FEK

CB'ER INTO HAM?

Reading your January issue, there is a letter from Ed Brooks Jr. W3GAB. Well I agree with him him 100% about the EIA proposal to allocate 146–148 MHz to CB hobby operations. Why get another mess started. If you give them another one of our bands, they may at a later date want more. As the saying goes, you give them an inch and they will take a mile. I know several CBers who are running against every regulation the FCC has put forth. I have converted a few of them to amateur radio. I showed them how easy it was to get a Novice ticket. I believe that if everyone who is a ham would get together with the CBers and show them how easy it is to become a ham operator, there wouldn't be a need for the EIA proposal at all.

William D Steen WA6HBM

This is where the local ham club plays a role in building PR. With another few hundred thousand hams our voice would be much louder.

EUROPE REVISITED

Top Tour and Swissair vacation plan as described in CQ for March may indeed appeal to some amateurs and be a good undertaking. But, one should carefully check what one is getting and total *all* the costs involved against other available plans. The Swissair ad in CQ makes reference to "1st Class Hotels." Some of those described under the plan are first class but some are definitely not. For instance, the "hotel" in Germany does not fall under any of the officially established categories of hotels of the first, second, third or fourth class. It is a so-called "Gasthaus" or inn. The hotel in Zweisimmen, Switzerland is officially listed as a hotel of the second to fourth class (depending on the room). The postal authorities in the countries mentioned who control the issuance of amateur licenses, are usually very friendly people, but the idea of obtaining your "own specialized personalized callsign," as the ad states, when native amateurs cannot generally obtain such service is stretching things. Your personalized call sign will usually be your W call followed by the normal country prefix, such as W8XXX/DL. There are other points one could mention such as: what does one see of Europe staying in insolated spots? Ever drive around in Europe during the tourist peak? Those 1–2 hour "theoretical" drives to sights of interest become 6–8 hour grinds. What is so DX'y about signing W8XXX/DL? There will be no pileups waiting to work you.

Name withheld

Visiting Europe during the summer months can be a terrible grind. My own preference is in May or in the fall – September and October, when the hotels have rooms, there are seats in the restaurants, and weather is just a bit cool, but not cold. I like the smaller hotels better than the first class Hilton type sanitized and plastic American type hotels. And who wants to sit in a hotel room watching a German-dubbed rerun of December Bride?

I'm on a 3-month business trip to Key West. Driving across country I worked into many FM repeaters and dutifully used your "FCC Official" log book that I got from the 73 booth at Las Vegas.

On the way down the Florida Keys my car with lots of antennas and the "FCC OFFICIAL" was spotted by a Citizen Bander at a service station. He passed the word down the Keys that the FCC was coming. There was a mad scramble to disconnect linears and lower antennas by the local CB'ers.

This info was passed on to me after I was here a couple of weeks.

Tom ORR W6EIF/4
Key West, Florida

These log books are available from 73 4/$1. They are designed to be used as FM mobile logs. The cover was designed to help keep fuzz off the car, the idea being to casually leave the log book on the dashboard with the "FCC OFFICIAL" facing upwards. The CB reaction is a side benefit, but one certainly worth pursuing.

CHAPIN REBUTTED

I would like to comment on your guest editorial in Jan. 72 issue of 73, which incidentally was a great way to begin the new year. An excellent edition (slim or otherwise!).

Admittedly, Mr. Chapin is well informed on the inner workings of the former IRE and AIEE, now IEEE and his arguments offer much for thought with regard to the ARRL and its obvious problems in the area of finances, membership & P.R., but to structure the ARRL in the manner he suggests is pure folly. I will agree that every organization goes through a cycle, beginning with its embryonic stage to its final plea for recognition, and ironically enough, that is where the similarity in our thin-ing also dies.

Forming a new organization by the act of merging does not guarantee continuity of the old organization, it is merely a way of saving face, in most cases, it is the final plea for recognition as mentioned earlier. Once the merger is complete the old organization is gone forever. I would like to know how Mr. Chapin is able to draw a parallel between the IRE & AIEE vs. ARRL & WHOM? *The ARRL simply has no competition.* How can you draw a parallel between the ARRL & CW & RC & TFC & Non/TFC & DX & etc.? Any rank SWL realizes that the real problem stems from the fact that *ARRL simply has no competition!* I know I repeated it, maybe by now it has sunk in somewhere between the head phones. Show me an organization or company with sole rights and distributorship of a product or service and I will show you an inferior product or service!

You know it, I know it, and Mr. Chapin knows it along with 200,000 other amateurs in the U.S. We live in a country whose economy is based and founded on competition, yet we sit on our tails for 50 years and let ourselves be led around and dictated to by an organization that claims 27% of our lot. C'mon fellows and YL's, wake up, we can do better than this!

For my part, since all the dissension began 3 years ago, and new organizations have cropped up (one of which is doing very well) and I'm proud to be a member of Nu Sigma Alpha, amateur radio has never been more exciting. Let's face it, competition is food for the soul, we all must have it, win or lose, we do the best we can for our colors. I can think of nothing more boring than to boast that I belong to the one and only major ham radio organization in the country. We've had 50 years of this drudgery, and another 5 or 10 years would parallel the Chinese water torture. So let's let ARRL continue the way they wish, let's develop one or two more organizations and with it develop some friendly competition for a change. It may uncover a few dusty old rigs, solidify the present membership of ARRL and bring back some of the competitive spirit into an area where it has been heretofore virtually non-existent.

Bob Linker WA9VIR
Chicago IL

I cannot agree with you more. It is only with competition that products improve and progress is made. Any company or organization that has a monopoly stands only to protect its monopoly and great efforts are often made to crush any smaller organization that threatens to upset the status quo. About a decade ago, a small group organized the Institute of Amateur Radio. This organization promised to make many resounding changes in our hobby; but this proved to be such an earth-shaker that the well established organization took great efforts to stop the competition.

What can be done now? Well, for a start, a new organization is needed to offer services, produce some sort of information disseminating system, and present ideas to its membership. The resultant competition need not be vicious nor cruel, but may be done with a keen eye to the other to see what is being done so that it may improve upon the latest offerings. The consumer has the ability to vote for the system he approves of most, and that vote he casts is in the form of the dollar. Obviously the organization that offers the most will win. That which offers nothing will stagnate.

The following letter was received by Peter Lovelock W6AJZ, for his role in saving two Navy aircraft from disaster.

I wish to thank you for the excellent assistance which you, as an amateur radio operator, gave the United States antarctic program on February 28, 1972. At that time two United States Navy LC-130 aircraft had been forced by headwinds to turn back on a flight from Christchurch, New Zealand, to McMurdo Station. Although the planes had been able to inform McMurdo of their change in plan, due to high latitude communication interruptions neither they nor McMurdo were able at that time to notify New Zealand or to request the needed lighting at the airports there.

By working an amateur circuit with Palmer Station you were perhaps the only person in the United States in radio communication with Antarctica at that time. By relay through Palmer, and thence through you to the Office of Polar Programs, McMurdo Station was able to report this operational emergency. We were then able to telephone New Zealand authorities to verify that the situation was known to them and that the airports were ready to receive the flights. Both planes landed safely.

Your prompt and capable assistance provided a reassuring backup communication capability for which all concerned are grateful.

Joseph O. Fletcher
Head, National Science Foundation
Washington DC

MARKETING MAGIC?

Reference the "thin 73" item at p.10 of the December 1971 issue. Was one of the Massachusetts bandits, by any chance, my favorite anathema, Herb Gordon of Woodchuck Hill? As your files will disclose I wrote you on Oct. 2, 1970, concerning my efforts to induce that individual to either ship merchandise ordered or refund my payment for it.

Ultimately I turned the matter over to my attorney and all normal legal steps of a preliminary nature were taken. Gordon blithely ignored all correspondence (including mine), so we decided it would be ridiculous to spend a couple of hundred dollars in court to recover $99.95, the amount of the check I had sent Gordon. I publicized his performance via a couple of OT organizations to which I belong. I wonder if he is still in business?

In any event, I'm minus the $99.95 – and the wattmeter.

Further concerning material in recent issues. You have indicated an interest in the possibility of introducing things of a new nature which might have departmental aspects. So how would you like to bankrupt the organization via a thing that might be entitled "Marketing Magic?" It would be concerned with the type of reaming I took from Gordon. It would report complaints from amateurs who, in fact or in fancy, have been victimized by suppliers. It would be based upon letters sent to 73 by victims such as W1GAA. It would contain nothing libelous, but would rather constitute a factual and objective record that would, hopefully, differentiate between the suppliers who deal above the table and those who don't.

Allowing for my undoubted bias, I think something of this nature would

(continued overleaf)

Caveat Emptor?

Price – $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor . . .

FOR SALE. Ross & White 1972 model FM transceiver with twelve channels and three frequency tone burst built in by the factory. Loudspeaker on front panel for best audio results. S-meter, hot front end, protected rf transistors, all crystals easily changed and trimmed, 0.1, 1.0 and 10 watt output, mechanical filter for selectivity, six IC's in one of the most modern circuits yet produced This transceiver sold for $405 with the 1800, 1950 and 2100 Hz tone burst. The first check for $200 will get this unit, brand new, used only for tests at 73 HQ. 73 Magazine, Peterborough NH 03458.

FET VOM's. CD IGNITION SYSTEMS. Nationally advertised. Good discount. All equipment guaranteed. Must see specs to appreciate. Rodgers & Son (73). Box 3583, Anaheim CA.

WARREN, OHIO ARA'S Family Hamfest, Aug. 20. Giant fleamart, swimming, picnicking, all free. Displays, mobile check-in. Camping Available. Yankee Lake, Rt. 7 near I-80. Details: QSL W8VTD.

A5 MAGAZINE: The all new ATV publication covering all modes of ham TV. Subscription $2.50 per year. Bimonthly. P.O. Box 6512-B, Philadelphia, Penna. 19138.

WILL TRADE a General Radio primary frequency standard model 1100-A for a Hewlett Packard signal generator model 608-D/E. The GR 1100-A will measure frequencies from 100 kHz to 50 MHz to 1 part 10^9 for short term stability. Complete with all manuals and cabinets and precision master oscillator, clock, comparator scope and transfer oscillators. Tech Editor, 73 Magazine.

GREATER INDIANAPOLIS HAMFEST Sunday Sept. 17, 1972. Gas Co. Park, on Thompson Rd. Between Franklin Rd. & Five Points Rd. Admission $1.00. Vendors Free Hourly Prizes, Refreshments. For info Write Bill Evans, P.O. Box 19449, Indianapolis, Ind. 46219.

FIGHT TVI with the R.S.O. Low Pass Filter. See p115, March 1972, 73. Write for brochure. Taylor Communications Manufacturing Company, Box 126, Agincourt, Ontario, Canada.

SALE OR TRADE: AN/URC-4 manual, 90 pages; AN/ART13,A,B manual, 400 pages, binder. WANT: Hanson Gorrill Bryan 100R phase-sensitive Voltmeter manual; Instrument Electronics 247 VTVM manual; 0–400V regulated power supply.

IRCC PICNIC/HAMFEST. Interstate all the way; 2 hours Chicago; 2 hours Cincinnati; 2 hours Louisville. July 9, FAIRGROUNDS, LAFAYETTE, INDIANA. Indiana Radio Club Council.

SALE – like new with original instruction book (3) Art 13 Autotune Aircraft Transmitters with all tubes, $50.00 each. Also: (3) new Panadapters, BC 1031 with spare tubes and power cord and original tech. manual. $70.00 each. Shipping costs collect. W3RYJ, R.D. 4, Box 368, Reading, PA. 19606.

FOR SALE Drake TR-6- with AC-4, MS4 RV6, AM filter. "Mint" $600.00. Will trade. Swan-TV2-B – $200.00. Jim – W1VYB, 53 Lothrop St., Beverly, Mass. 01915.

FIFTH ANNUAL RADIO SOCIETY OF ONTARIO Convention – Kitchener, November 3 and 4, 1972. Canada's Biggest – excellent forums for OM's and XYL's. Write R.S.O. Convention, Kitchener-Waterloo Amateur Radio Club, Box 812, Waterloo, Ontario, Canada.

TECH MANUALS for Govt surplus gear only $6.50 each: R-388/URR, R-389/URR, R-390/URR, R-390A/URR, R-220/URR, R-274/FRR, CV-591A/URR, TS-497B/URR, URM-25D. W3IHD, 4905 Roanne Drive, Washington, DC 20021.

CLEANING OUT SHACK, garage and attic. Six new surplus 6C21 triodes, misc xmfrs, chokes, caps & xtals. List available. WA7OTN, 185 East 550 North, Bountiful, Utah 84010.

BUYING? SELLING? TRADING? Don't make a move until you've seen our new publication. Free sample copy! Six issues $1. HAM ADS, P.O. BOX 46-653R, L.A., Cal. 90046.

FIELD DAY masts: 9½' x 3" o.d. aluminum alloy; extremely rigid; 20 lbs. each. $8.25 each. Kleinschmidt teletypewriter (KSR), very good condition, $49. Model 14 reperf, good condition, $15. Unused: 4CX250K, $38; 4CX300A, $26; 4X150A, $17. Aircraft emergency horn, 28v@5.5A (loud!), $35. New 28LPR reperf in ognl sealed carton, $79. RCA4500 vidicon for SSTV, unused, (New: $480), $99. K3MNJ, 8361 Langdon St., Phila. Pa. 19152. Tel: 215-725-2373.

LETTERS CONT.

be a real service to all hams. But of course it might take 73 out of the picture – or, like the various consumer's magazines, it might start a boom for you.

I'd be delighted to edit such a column. What do you think?

Al Smith W1GAA/K3ZMS
Temple NH

There are a few cases where a warning to the reader is in order, but a good percentage of the complaints that have been received at 73 have been exaggerated. The 73 policy has been to refuse further advertising to firms which generate legitimate complaints from customers. A good percentage of the 73 advertisers are involved with mail orders so we try to do everything we can to make sure that everything is on the up-and-up. 73 is also suing Mr. Gordon, though not with any remarkable success.



Be The First!

Are you going to let the EIA steal one of our most promising ham bands without a fight? Are you going to sit still while this piracy takes place? Or are you going to fight back? Are you going to get on 220? Are you going to help get a repeater on 220? Are you going to let the manufacturers know that they can't buy our ham band by lavishing dollars in Washington?

To help you get the spirit started with your club 73 is offering these shirts – 220 – USE IT OR LOSE IT – you may be the first in your club and make everyone eat their heart out. Wear these to hamfests and conventions – let's get the word out.

These 220 shirts are $2.50 each postpaid – state size desired – small, medium or large – state color desired as long as it is blue. USA only.

73 Magazine, Peterborough NH 03458

Peter R. Jennings VE3GEJ
600 Peach Avenue
Niagara Falls, Ontario

SIX ELEMENTS ON TWENTY METERS

Literally hundreds of articles have been written over the past few years describing antenna arrays ranging from dipole simplicity to full-size 40m quads. Still, it seems that most hams do not have as good an antenna system as they would like to have. There are two major reasons for this: They don't have the room or they don't have the money. Well, here is a high-gain antenna which was built in a 55 x 35 ft back yard at a total expense of about $5 for antenna wire plus some leftover hardware from a 75m dipole.

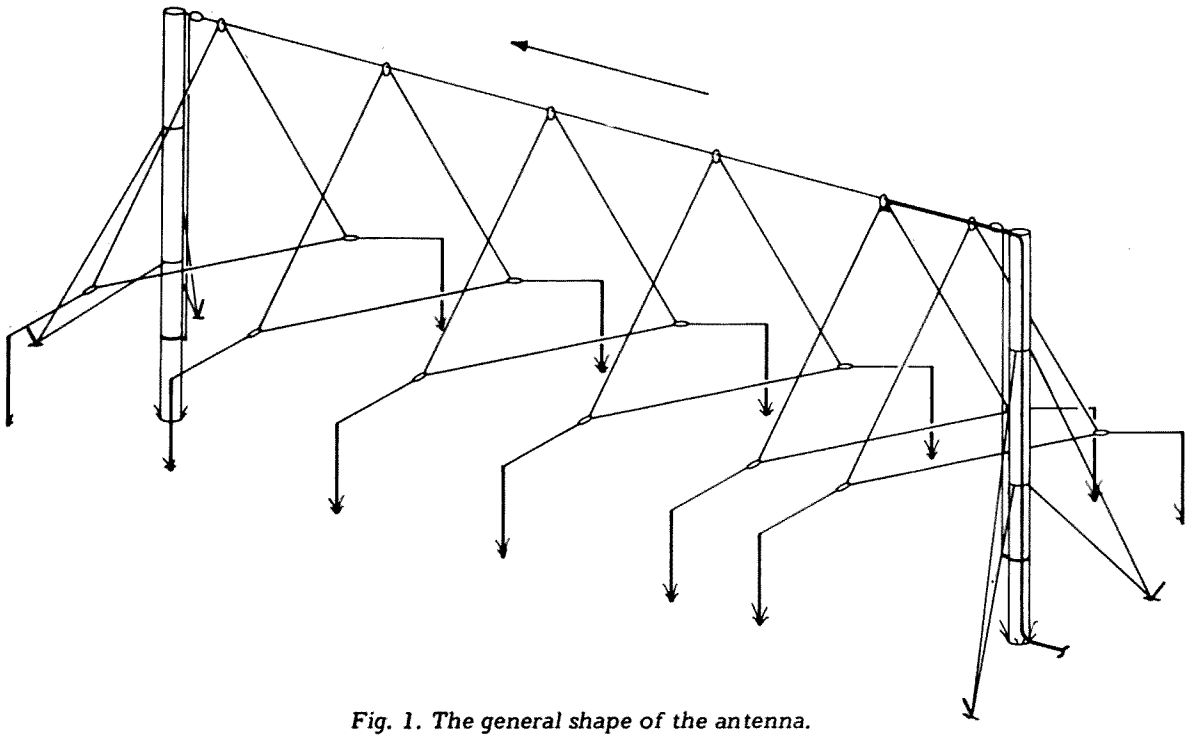


Fig. 1. The general shape of the antenna.

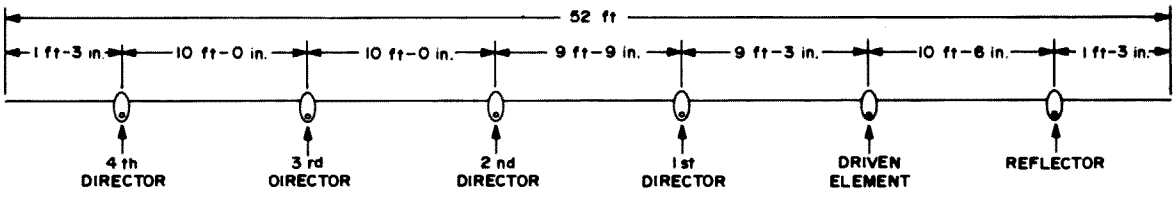


Fig. 2. Spacing of the elements on the support wire.

Checking back over the past two years of 20m operation I discovered that 62% of all contacts were with stations in Europe. The remainder were mostly contacts in Canada, South America, and a small country to the south known as the U.S. Although I was working a fair number of stations, the reports were usually, "You have a good signal here, but there is plenty of QRM on the frequency, 73 and hope to see you when the band is quieter." Of course, the band has not yet quietened down. Since I enjoy ragchewing much more than the quick "report exchange" contact, I decided to take stock of what I had in my junkbox and build the best unidirectional antenna I could devise in the space available.

My search complete, I came up with two 33 ft TV masts, a few hundred feet of guy wire, and a box of egg type strain insulators. After purchasing 450 ft of antenna wire, a roll of nylon clothesline, and two small pulleys, I had all the parts for my superbeam. Several months ago I had the idea of suspending a quad from a wire boom. Closer examination of this idea showed that if the square element configuration was to be used, two booms would be required, if the diamond configuration were to be used it would be difficult to form the square shape necessary and the elements themselves would almost touch the ground.

Suddenly while playing about with different element configurations, I realized that the most compact shape with a 1λ perimeter would be a triangle. So I came up with the antenna shown in Fig. 1. This requires only one supporting wire, and the element shape can be adjusted so that the height above ground is about 7 ft. Although this sounds low, it turns out to be just high enough to mow the lawn, yet low enough to reach easily for pruning. With the guys which hold the elements in shape attached to a fence at the edge of the yard, the forces are directed to the side instead of downwards, thus putting less stress on the supporting wire.

Although I will explain the method of construction in considerable detail here, the mechanical structure is not very critical and is only presented for the use of those who wish to duplicate my antenna exactly.

First, measure off a 52 ft length of guy wire, which will be the supporting cable. Slide six of the strain insulators onto the wire and space them according to the

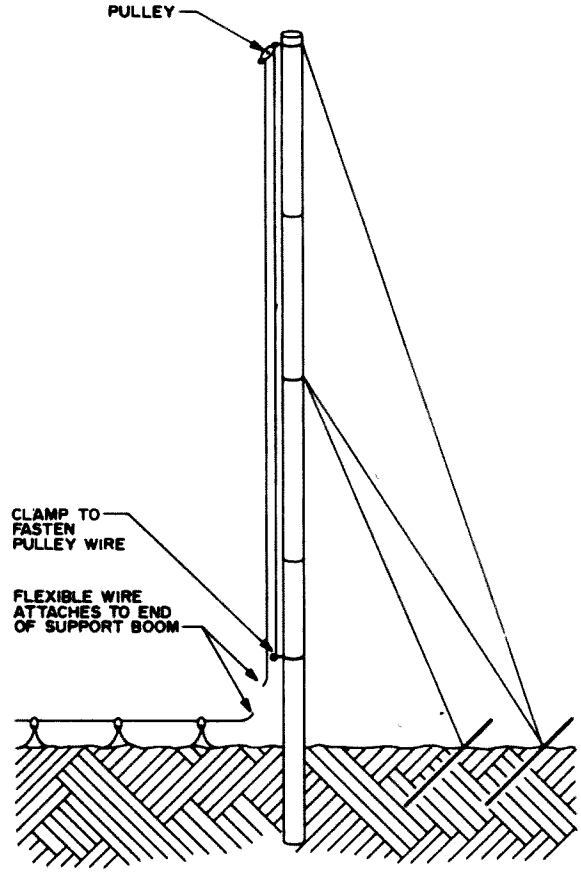


Fig. 3. Details of masts. Do not anchor guys to ground until the mast is vertical. Then tighten guys as tension on the antenna is increased.

spacing shown in Fig. 2. The insulators I used have the two holes drilled perpendicular to each other, which makes them excellent for supporting the elements of this antenna. Electrical tape was used to hold them in position.

Second, set up the masts according to the details of Fig. 3. The poles I used are TV masts made to a length of about 33 ft each by adding three 10 ft sections with swaged ends and a 4 ft scrap of tubing to be buried in the ground. A pulley is attached to the top of the mast and 50 ft of flexible guy wire is pulled through it. This will be used to lift the antenna into position after the masts have been erected and lower it for changes or servicing. Two guys attached adjacent to the pulley are used to balance the tension on the supporting wire. In addition, two more guys are attached halfway up the masts to hold them straight. The entire assembly is light enough to be walked up into the vertical position and dropped into a 3–5 ft hole. The earth can then be filled in around the mast and the guys temporarily anchored.

Next, measure the wire for the elements according to the table in Fig. 4 and insert the wire in the insulators as shown in Fig. 5. Make sure you do not mix up the elements at this point. Add two more insulators to each element and spread the wire out on each side of the boom so that it will not tangle when the antenna is being lifted into place. The feedline should be attached to the driven element and taped along the support wire to the end nearest the shack. Any 50Ω coax will work well (depending on the power you are running). Incidentally, the loss in RG-8 is 0.7 dB/100 ft. The loss in RG-58 is 1.7 dB/100 ft. In watts that means that 100W output from the transmitter at the end of 100 ft of RG-58 is only 68W at the antenna. But with RG-8, 100W at the transmitter means 83W at the antenna.

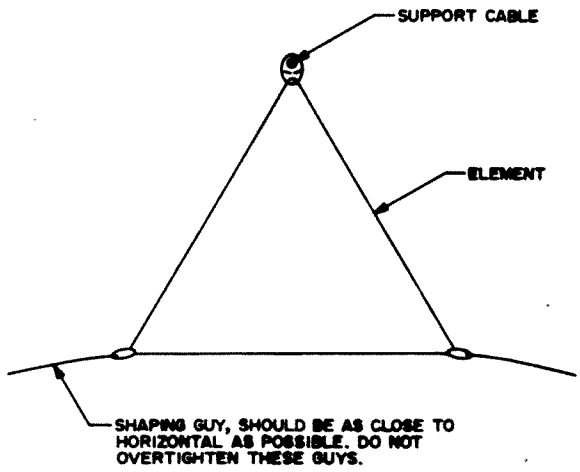


Fig. 5. Details of the element mounting.

Next, attach the support wire ends to the wire on pulleys of the masts and hoist the antenna into the air. Attach nylon clothesline or heavy string to the insulators and pull the elements into a triangular shape. These guys should be attached as far from the antenna as possible or even better as high from the ground as possible. This is to prevent the strain of the guys from pulling the support wire out of shape.

Now you are ready to prune the elements. This can be done by setting a field strength meter in front of the antenna and trimming the elements for a maximum reading. If this is not possible, a reasonably good approximation can be made by resonating the elements to the frequencies shown in Fig. 4 with a grid dip meter. To be sure that the calibration of the grid

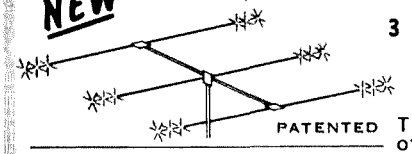
Element	Length of Wire Needed	Resonant Frequency
Reflector	71'9"	13.8 MHz
Driven Element	70'0"	14.17 MHz
First Director	68'3"	14.60 MHz
Second Director	66'6"	14.90 MHz
Third Director	64'9"	15.40 MHz
Fourth Director	63'0"	15.90 MHz

Lengths are given for a resonant frequency of 14.170 MHz. If the frequency is higher, they should be shortened accordingly. IMPORTANT: These lengths are rough estimates and should not be used without pruning with the antenna in the air.

Fig. 4.

• LEADERS IN COMPACT ANTENNAS •
MAXIMUM EFFICIENCY/MINIMUM SIZE
FOR APARTMENTS • SUBURBAN HOMES
Marine and Portable Operation
Packaged for APO and FPO Shipping
ALL MODELS COMPLETELY WEATHERPROOFED

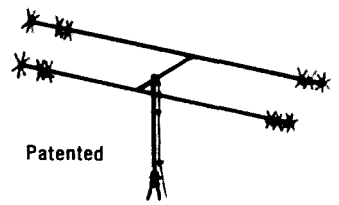
NEW
B-24 + RK-3 COMBINATION
3 ELEMENTS
10-15-20
METERS


PATENTED

Bands	10-15-20 Meters
Power Rating	1400 Watts P. E. P.
Total Boom Length	11'
Turning Radius	7'-10"
Total Weight	23 lbs.
Single Feed Line	52 ohm
SWR at Resonance	1.5 to 1.0 max.

The features of the popular B-24 plus the new RK-3 reflector kit make a unique 3 element combination. Choose the combination or add the RK-3 to your present B-24 and enjoy the improved gain and front to back.

B-24 + RK-3 Combination Net $94.95
RK-3 Reflector Kit (only) Net $36.95


Patented

6-10-15-20
METERS

The time proven B-24 4-Band antenna combines maximum efficiency and compact design to provide an excellent antenna where space is a factor. New end loading for maximum radiation efficiency. No center loading.

Bands	6-10-15-20 Meters
Power Rating	1400 Watts P.E.P.
El. Length	11'
Turn. Radius	7'
Total Weight	13 lbs.
Single Feed Line	52 ohm
SWR at Resonance	1.5 to 1.0 max.

Model B-24
Net $62.95

MULTIBAND COAXIAL ANTENNA
for 6 - 10 - 15 - 20 METERS

Needs no ground plane radials. Full electrical ½ wave on each band. Excellent quality construction. Mount with inexpensive TV hardware. Patented.



Power Rating	1400 Watts P.E.P.
Total Weight	6 lbs.
Height	11'
Single Feed Line	52 ohm
SWR at Resonance	1.5 to 1.0 max.

Model C4 Net $36.95

See our entire line at your nearby distributor or write the factory for further information and literature.

Mini-Products, Inc.
Call 814 - 454-2171
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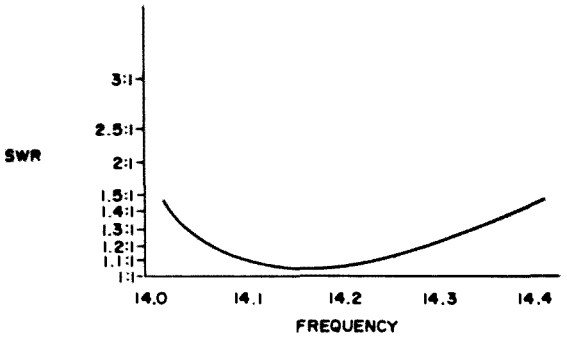


Fig. 6. A plot of swr vs frequency shows that the antenna is quite flat across the entire band. In fact the swr does not exceed 1.5:1 on any frequency.

dipper is not being pulled by the antenna element, a communications receiver can be connected to the antenna which will pick up the signal and assure accurate calibration. Last, trim the driven element for a minimum swr.

The first time I plugged the antenna into the transmitter I thought something had gone wrong with my swr meter. No matter how far I advanced the sensitivity I could not get a reading in the reflected position. The swr was a flat 1:1. The final resonance swr is shown in the graph of Fig. 6.

The first station I worked was OZ7KB, who reported my signals to be S9, and one of the few VEs coming through at that time. Receiving, his signals were also S9. A few more contacts with more S9 reports using 150W PEP confirmed that the antenna was working well.

Comparison reports with a vertical show a consistent 10 to 15 dB gain on both receive and transmit. The antenna has the added bonus of cutting out the QRM I used to get from the South American kilowatts.

Since I am no antenna engineer, I cannot give any rigid theories as to how or why this antenna works. I do not even know what the polarization is. All I can say with certainty is that it works for me and I am quite pleased with its performance. Incidentally, I do not see why the antenna can't be extended to more elements if the room is available. Like, how about a cheap 12-element 20m beam?

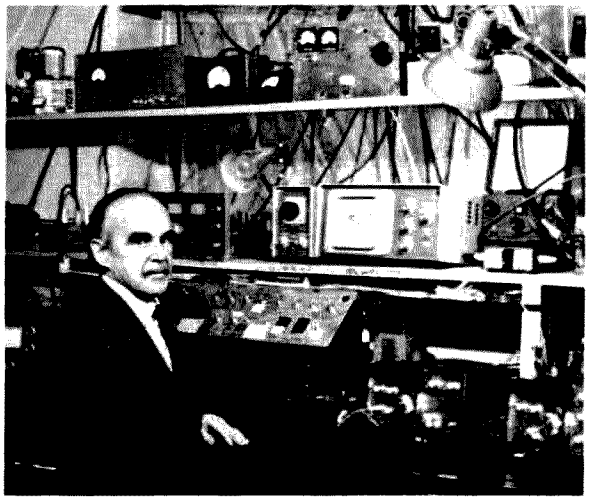
. . .VE3GEJ■

Harold Jones G5ZT
3 Bircham View, Austincres
Egg Buckland, Plymouth
Devon, England

SLOW-SCAN TELEVISION

"Slow Scan? What is that, OM?"

Yes, believe it or not, that is the question I am asked time and time again when I have transmitted amateur television Slow Scan pictures on 14230 kHz and announced the fact on SSB, only to find some DL, OK, SM, and even W/K station responding as if I had only transmitted a phone CW call. When I reply that I am ready for Slow Scan transmissions and ask, "Have you that facility?", they appear puzzled:



G5ZT at his station.

"Slow Scan? What is that, OM" When I explain that I have been sending Slow Scan amateur television pictures, they invariably say something like this: "Sorry, OM, I did not know that sound was Slow Scan. I have often heard it but thought it was some commercial RTTY or high speed Morse – I deliberately used the frequency for testing and tuning-up purposes. Television on these DX bands would be most interesting . . . please explain all about it and tell me how I can get equipment going and where I can get the equipment or circuits."

Hence this article to explain in simple terms what SSTV means and what equipment is required. Much has been written about this subject but it seems to me that it has been too technical for many amatuers. They have just given the article a cursory glance and then forgotten all about it.

SSTV is a means whereby amateurs can transmit and receive television pictures world-wide using the normal narrow band wavelengths in the amateur bands of 80, 40, 20, 15 and 10 meters.

All amateurs will understand the principles of commercial broadcast television.

DRAKE TR-22

Versatility plus!...in a 2 Meter FM Transceiver



Over-the-shoulder, mobile, or at home

Completely transistorized, compact, portable. Capacity for 6 channels. Built-in telescoping antenna, and connector for external antenna. Use barefoot or with accessory amplifier. External 12 VDC or internal ni-cad batteries, built-in 120 VAC battery charger.

Complete with: Dynamic Mike, O-T-S Carrying Case, 120 VAC and 12 VDC Cords, Speaker/Headphone Plug and 10 Ni-Cad Batteries.

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AA-22 Amplifier $149.95
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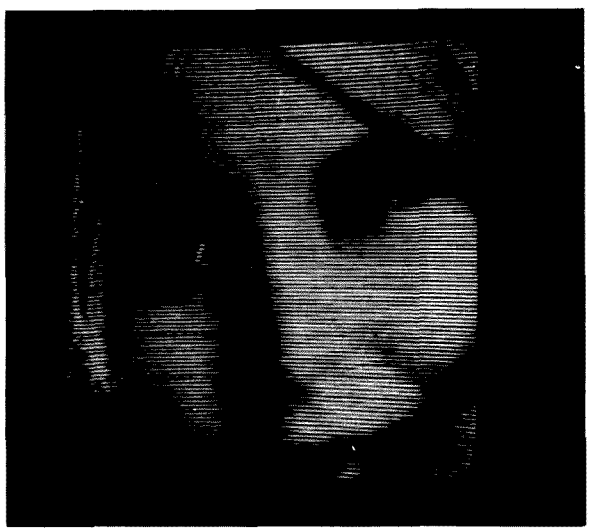
GENERAL: • Freq. coverage: 144-148 MHz • 6 channels, 3 supplied • Push-to-talk Xmit • DC Drain: Rcv, 45 mA; Xmit, 450 mA • Size: 5-3/8" x 2-5/16" x 7-1/8", 3-3/4 lbs.

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SSTV DX! Transmitted by W4LAS, the picture is of his niece.

This must be transmitted and received on VHF or UHF because of the wide bandwith – anything from 2 MHz to 6 MHz depending on the country. To use a minimum of 2 MHz bandwidth for amateur televison means that hams have to use the 432 MHz or even higher frequency bands, which they do, but activity is comparatively low and communication is normally only a few miles, seldom out of the amateur's own country.

By using SSTV, television pictures can be transmitted using a bandwidth of no more than 2.5 kHz so that transmission is perfectly possible in the 80 to 10 meter bands where world-wide communication is quite normal. Not only is this possible, but, because of the narrow bandwidth used, it easily complies with international regulations, covering no wider a channel than SSB does and even less than that of AM or FM.

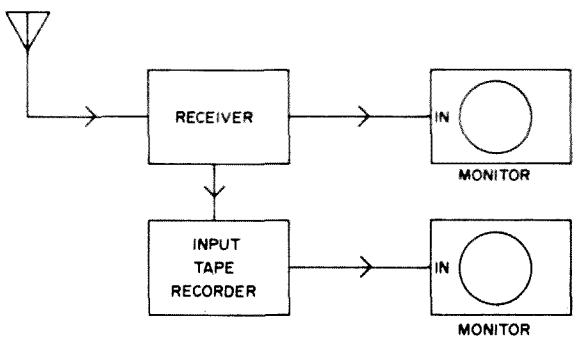


Fig. 1. Block diagram of interconnections for the short-wave viewer and transmitter for television reception.

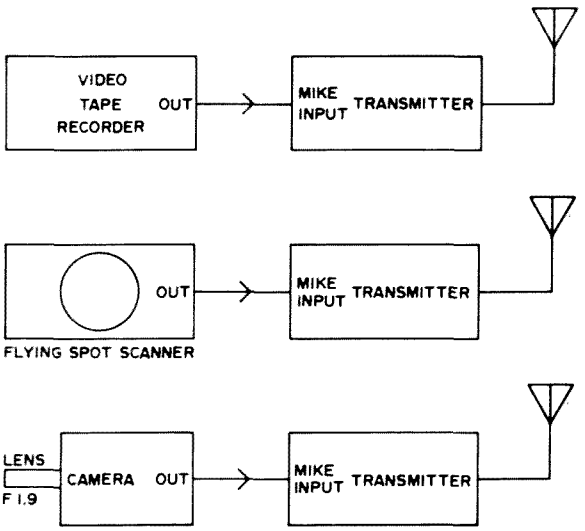


Fig. 2. Block diagram of interconnections for the transmission of pictures.

The difference between amateur television on 432 MHz, where objects can be seen moving, and SSTV, is that the picture must be static. Call signs, photographs of self, yl, xyl, family, shack, cartoons and written messages can be easily transmitted anywhere in the world with surprisingly good definition. But it is fascinating to contact a station 10,000 miles (or even 50 miles) away and exchange a series of pictures.

To make this technically feasible on a world-wide basis, a standard has been reached which all SSTV amateurs use, as follows:

Number of lines	120
Time per frame	8 seconds
Modulation (white)	2300 Hz Modulation FM
Modulation (black)	1500 Hz
Sync.	1200 Hz
Sync duration	
Horizontal	5 milliseconds
Vertical	30 milliseconds

Normally after transmitting video signals, the same frequency is used for sound to announce the fact that you are looking for slow scan contacts. Although technically it is possible to use vision and sound simultaneously on either sideband, I have not heard of this method in use yet. For reception of the pictures, all that is necessary is for the output from your communication receiver speaker terminals to be fed into a cathode ray assembly called the monitor.

The cathode ray tube is the special long-persistence type, usually P-7 phosphor. The incoming signal is truly slow scan and, unlike commercial television which appears to be instantaneous due to the high line and frame rate, appears to *paint* the picture from the top left to the bottom right of the cathode ray tube, taking a total of eight seconds to complete the picture on the tube. That is why you have to use a P-7 phosphor. When this eight second period reaches the bottom of the tube, the sync signal starts the process over again. The normal practice is to transmit each picture for three or more frames, enabling the receiving amateur to get a full picture and tape record. Intensity of the picture is frequency – modulated according to the standards already listed, i.e. for highest brightness, 2300 Hz, for black, 1500 Hz, and for line and frame synchronization by 1200 Hz blacker than black pulses at the line and frame rates. The bandwidth is thus limited to the normal voice grade communication frequencies into the transmitter microphone socket for transmitting and into the receiver circuits for reception.

Now don't think that this is too complex for you. I only commenced operating in this mode on April 22, 1971, and have already had over 80 two-way television contacts with Greece, Sweden, Italy, Alaska, U.S.A., Puerto Rico and Guadeloupe Island. I have received short-wave viewers' reports from Norway, Russia, Czechoslovakia, Singapore, Austria and Australia. This should prove to the doubters what a great deal of activity



Typical logo used by SSTV hams.

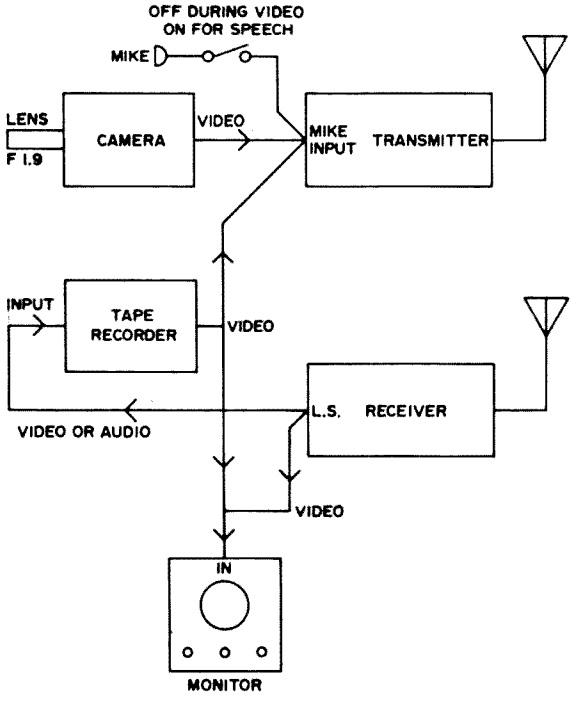


Fig. 3. SSTV interconnections at G5ZT.

there is; it is increasing daily. I understand that there are over 30 countries using SSTV and that some amateurs already have over 20 C. to their credit. I predict that by 1975 the first DX/CC/SSTV certificate will have been issued.

It is a pleasure to find the slow scan amateurs such a friendly bunch, with no rush to get rid of you for the next QSO. Contact for an hour or more is quite normal and the experts are always willing to give you every assistance and advice. The most popular frequencies in use are 3845, 3740, 7050, 14230, 21100, 21430, 28100 and 28600 kHz, the two main long distance frequencies being 14230 and 21430 kHz.

All you have to do is to tune your receiver to the signal which sounds similar to RTTY or high speed Morse with a noticeable "pip" every eight seconds. If you hear the station on sound then that is the correct tuning position to receive the picture.

A tape recorder is almost a "must," since you should tape all signals. Then you can play them back at leisure for checking purposes, proving reception to your friends or taking photographs of the pictures.

For transmitting you can use any of the following methods to feed the picture into your transmitter microphone socket:

1. Use a video tape recorder. Get an SSTV amateur to make a video tape of your call sign, photographs, etc. All you do is feed recorder output into your transmitter microphone socket.
2. Use a Flying Spot Scanner. With this, you can make up your own version of your call sign to feed into the transmitter.
3. Use a video camera. This is the ultimate for SSTV. You can have a target stand in front of the camera on which to place any writing or photographs or you can turn the camera on yourself, your shack, etc. Camera output again is fed into the transmitter as in the other methods.

The video signal is adjusted to give the same transmitter rf output level as your voice peaks, or just slightly lower, being careful on SSB not to go beyond the specified carrier insertion levels or, if using an AM or FM transmitter, the same levels. If, for example, your SSB transmitter instructions say speech peaks of 150 mA, then I would adjust the video level to around 100 mA.

If you build your own equipment, see the appendix for numerous articles on equipment. If you want to get on the air quickly by purchasing commercial equipment, there are three firms that I know of producing equipment:

Robot Research Inc., 7591 Convoy Court, San Diego CA 92111. Camera and monitor.



The ID picture of FG7XT, as received in England by G5ZT.



This is how SM4AMM must look after receiving TVI complaints.

L.E. Babcock & Company, Inc., P.O. Box 281, Acton MA. SSB transceiver with SSTV add-on units. See 73 magazine May 71.

E.K.Y. Video Vision Co., Box 15, Stockholm NJ. Monitors, monitor kit sets. See 73 magazine April 71.

It will take you no more than one hour after receiving the ready-made equipment to be on the air . . . as simple as that! Reception is remarkably good since even signals as low as S3 will provide a picture and S7 signals will take a lot of QRM punishment. Various simple cabling connections for the viewer and transmitting amateur are shown in Figs. 1 and 2.

The big advantage of taping all contacts is that you can edit the tape, keeping the best pictures and sound reception as a permanent record to photograph at your leisure. I used a standard Philips tape recorder which cost me $10 secondhand, and I bought an ordinary camera for $20. Having set up the camera for correct aperture and focal length, give the film an eight second time exposure when the picture on the monitor starts at the top. It will take eight seconds to reach the bottom. The photographs in this article were taken by this method. Times for long distance communication will be the same as for phone contacts mainly operating on 14230 kHz or 21430 kHz. It is just a question of being on the air at the right time to catch the DX – often 0300 GMT for me!

. . .G5ZT

Appendix.

Macdonald, C. "A New Narrow-Band Image Transmission System," *QST* August and September, 1958.

Macdonald, C. "Slow-Scan Image Transmission, A Progress Report," *QST* April, 1960.

Macdonald, C., "S.C.F.M. An improved system for Slow-Scan Image Transmission," *QST* January and February 1961.

Plowman, J.A., "Slow-Scan Picture Transmitter," *The British Amateur Television Club*, London, 1961 (out of print).

Macdonald, C., "A Compact Slow-Scan TV Monitor," *QST* March, 1964.

Macdonald, C., "A Slow-Scan Vidicon Camera," *QST* June, July and August, 1965.

Macdonald, C., "Twenty-Meter Slow-Scan Tests," *QST* September, 1966.

Simpson, R., "Narrow-Band TV Using Pseudo-Random Dot Scan," in Technical Correspondence, *QST* January, 1967.

Sulu, G.V. (Editor), Amateur Television Issue, *SIRAN* Journal of the Bangalore Amateur Radio Club (South India Radio Amateurs Newsreel), March, 1967.

Cohen, T.J., "An Economical Slow-Scan Television Monitor," *73* July, 1967.

Hutton, L.I., "A Slow-Scan Television Picture Generator," *73* October 1967.

Anon., FCC Proposal on Slow-Scan TV, *QST* November, 1967.

Anon., ARRL Comments on FCC Proposal on Slow-Scan TV, *QST* February, 1968.

Anon., F CC Approval of Slow-Scan TV Docket, *QST* September, 1968.

Taggart, R.E., "Slow-Scan with Regular Vidicons," in Technical Correspondence, *QST* December, 1968.

Hutton, L.I., "A Fast-Scan Vidicon in the Slow-Scan TV Camera," *73* February 1969.

Watson, D.J. and Horne, S.M.K., "New Solid-State Camera and Monitor for Slow-Scan Televison, *Ham Radio* April, 1969.

Popkin-Clurman, J.R., "A Simple Inexpensive FM to AM Converter for Slow-Scan TV and Facsimile,' *73* June, 1969.

Hutton, L.I., "A Slow-Scan Television Signal Generator," *73* July, 1967.

Miller, D.C., "Slow-Scan Television" *CQ* July and August, 1969.

Taggart, R.E., "A Procedure for the Reception of Slow-Scan Color Pictures Using Additive Synthesis," *73* November, 1969.

Backman, A., "SSTV" *73* December, 1969.

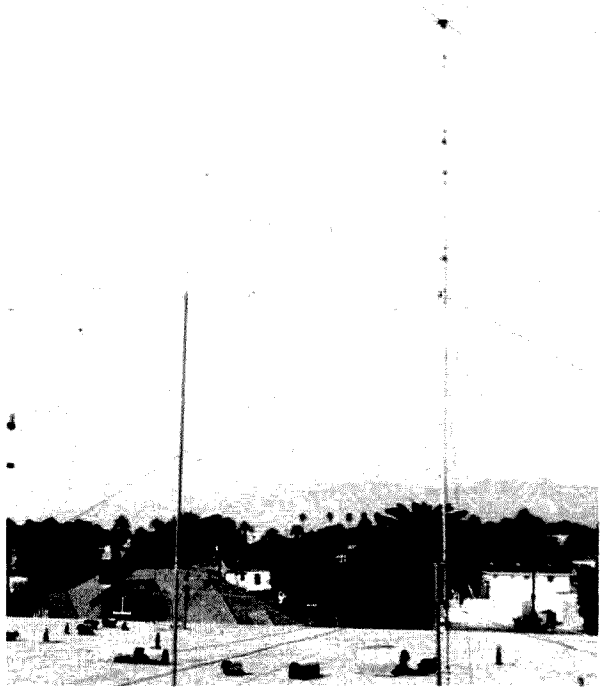
Taggart, R.E., "Slow-Scan Television," *Ham Radio* December, 1969.

Cohen, T.J., Harmon, D., and Veazey, D., "Sampling Techniques," in, Taggart, R.E., "Slow-Scan Television," *Ham Radio* December, 1969.

Backman, A., "Slow-Scan Television, Radio Communication"*(R.S.G.B.)* February, 1971

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BEAMING the VERTICAL ANTENNA



The user of a groundplane or trap-vertical type antenna experiences the limitations of its omnidirectional characteristics. Heavier QRM during reception and reduced radiation in a desired direction are inherent to this type of antenna, despite the low vertical angle of propagation which is favorable for DX work.

One classic solution is to utilize two identical verticals, spaced ¼-wavelength apart, and phase driven with an appropriate length of interconnecting feedline. Such arrays will exhibit a cardioid or "figure-8" horizontal pattern, dependent upon the phasing-line length and feedpoint. This arrangement is suitable only for single band operation due to the phasing requirements, and in the case of trap verticals may involve the significant expense of the duplicate antenna. The directional pattern is broad, fixed to the plane of the twin antennas, and can only be reversed by somewhat complex coaxial switching of the phasing line.

The fact that verticals lend themselves to the application of parasitic elements in Yagi-type configurations, seems to have been somewhat neglected. The purpose here is not to give detailed construction of such an array, but rather to present some ideas which I have found to accomplish effective directional characteristics for my commercial trap vertical. These are equally applicable to any ¼-wave vertical, and may be adapted to the needs and space availability of the individual. The final section describes how such parasitic elements may be fabricated from readily available materials at very modest cost.

Vertical Reflector

The simplest application of a parasitic element is a vertical reflector spaced 0.25 wavelengths from the groundplane driven element. The photograph shows a 21 MHz reflector used in conjunction with a popular trap vertical. Figure 1 illustrates the arrangement of the reflector with a single band groundplane antenna.

0.25 wavelength spacing between elements is suggested for several reasons: (a) It affords the optimum gain for a single parasitic element. (b) The reflector length is an electrical ¼-wave at this spacing to achieve correct phase relationship. (c) The base of the reflector should be connected to the same electrical ground as the antenna. This may be achieved by

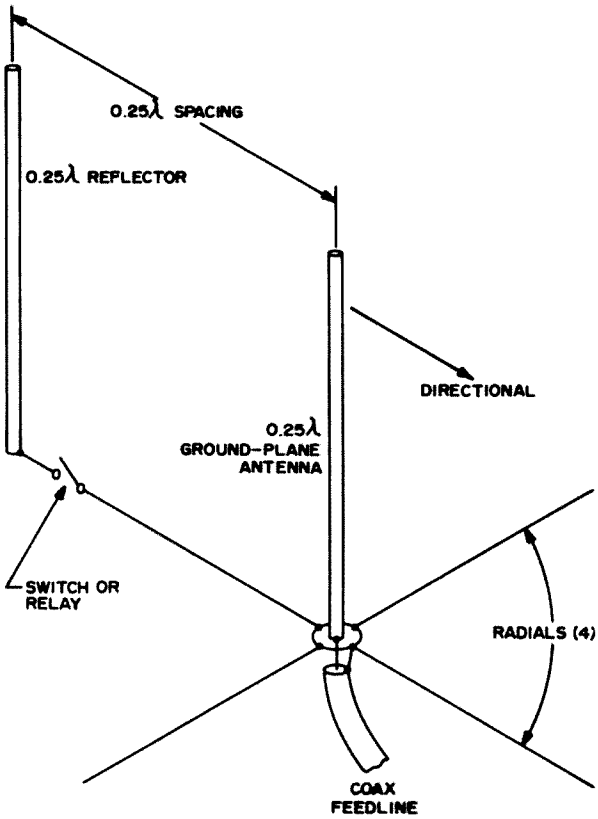


Fig. 1. Simple reflector for ground plane antenna.

connecting it directly to the end of one radial used with a groundplane. (If the vertical antenna is ground mounted without radials, a ¼-wave wire should be run from the base of the reflector to the antenna feedpoint ground.) (d) 0.25 wave spacing has the minimum effect on the antenna's radiation resistance, and thus minimum change to feedline matching and SWR.

If the base of the reflector is otherwise insulated, the element may be made non-functional by breaking the connection to the radial wire. This can be done by inserting a switch, or remote operated relay, close to the reflector base. Directional or omnidirectional operation may then be selected at will.

True, the single, fixed position vertical reflector is constrained to "beaming" in one direction. But when some added punch to a particular part of the world is desired, the 5 dB gain from this simple expedient is well worth a few dollars for the aluminum tubing used. The equivalent increase of x4 power would cost up to one hundred times as much.

Director elements may be added in-line for improved gain and front-to-back ratio. However, to achieve worthwhile results directors must be spaced 0.1 to 0.15 wavelengths from the antenna (and each other). This requires that they be adjusted to an electrical length shorter than 0.25 (dependent on actual spacing) for correct phasing. The additional elements and close spacing will significantly reduce the antenna feedpoint impedance, requiring special matching arrangements if SWR is to be kept low on the feedline. This is not conducive to switching out the parasitic elements for omnidirectional operation, unless a complex relay system is acceptable. For the 2–3 dB extra gain, the cost and effort increases out of proportion, and the single reflector offers the most for the least.

For those who desire it, formulas for deriving the proper length to spacing of directors are the same as those used for horizontal Yagi-beams, divided by 2.

Variable Directivity

While the single fixed reflector provides an easy method of fixed direction beaming, the ability to vary directivity may be ultimately desirable. Figure 2 depicts an array utilizing four fixed directors arranged around the vertical antenna at 90° intervals. The eight-position switching system shown operates relays at the base of each reflector, so that one or two reflectors are activated for a given switch position. This effectively allows 360° rotation in 45° steps. Since the beam width with a single reflector, at ½ power points, is approximately 60°, the rotational capability is pretty adequate.

A simpler version can be made using a four position switch, and accomplishing electrical "rotation" in 90° steps. However the difference in cost is just that of the switch.Another method of beam rotation, applicable to the 28 and 21 MHz bands, is shown in Fig. 3. Here the reflector (and if desired, director) are mounted on a rotatable boom. The boom is attached to a bearing and bracket assembly, clamped to the mast which supports the vertical antenna, and is at "ground" potential. The boom can be rotated by the "armstrong" method, and incorporate a means of locking in a

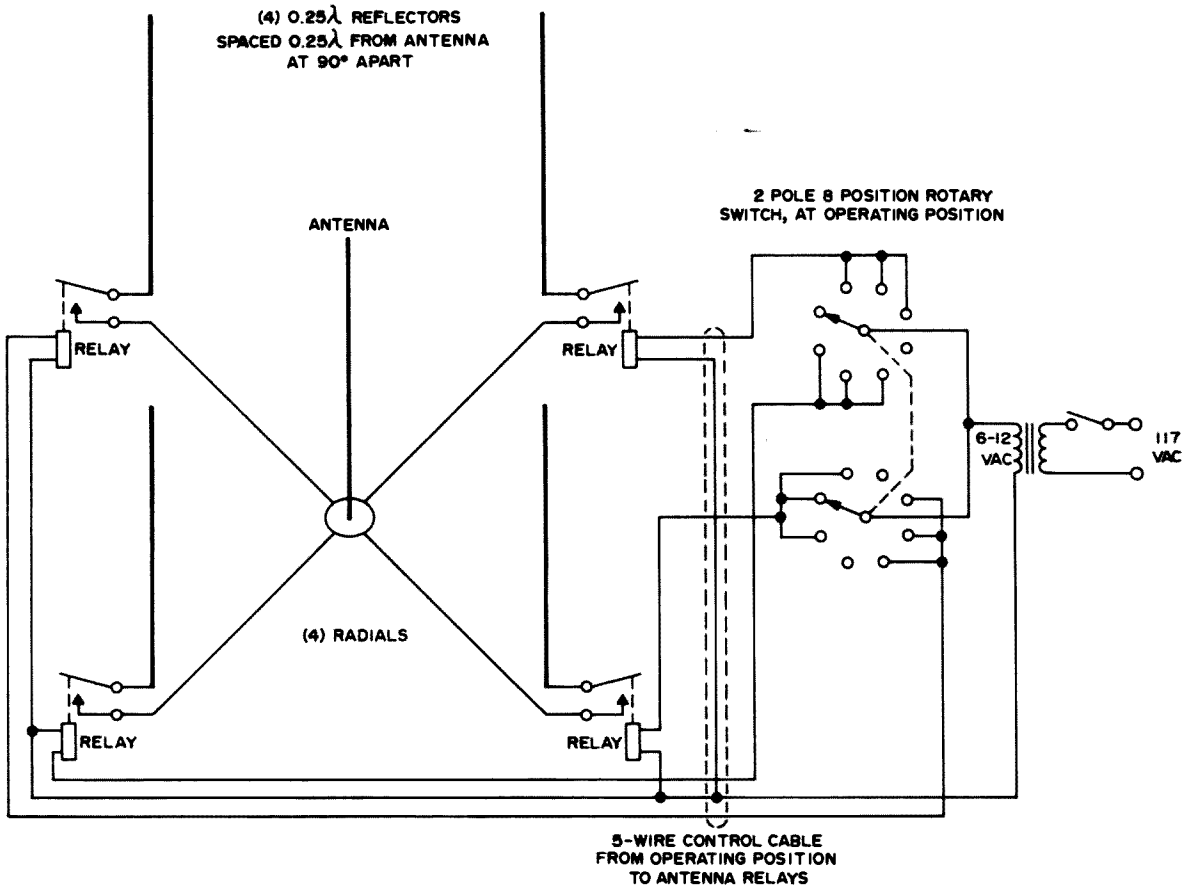


Fig. 2. Four reflector array for variable directivity.

prescribed direction. Or a suitable motor drive will permit remote operation from the shack.

The parasitic elements may be clamped directly to the boom, in which case the permanent electrical connection will not allow for omnidirectional use of the antenna. If the latter is desired, the parasitic elements must be insulated from the boom and connected by relay switching for beam application. Detailed methods appear under the constructional section below.

A single boom may incorporate parasitic elements for both 28 and 21 MHz, either by using separate elements of the right length and spacing or, alternatively by using a method described under the "Multi-Band" section that follows. In the latter case a compromise in spacing will be necessary.

Multi-Band Applications

So far we have considered using parasitic elements basically for a single band. For those who have a favorite DX band, this may prove adequate. But for the man who has a five band trap vertical, and wants to benefit from DX on more than one band, the problems multiply.

If you have a lot of real estate, or a very large flat roof and complacent neighbors, you can extend on the method of Fig. 2. All it takes is four more reflectors and relays for each band, suitably spaced from the trap vertical. This is possible for 28 through 14 MHz. For lower frequencies, full length ¼-wave reflectors get to be big and cumbersome, and a full 5-band array with 20 assorted elements is an unlikely prospect for the majority.

The situation can be compacted by using a 3/8-wave reflector on the upper of two bands; say 14 and 7 MHz. The reflector will be long on the higher frequency band and display inductive reactance. This may be adjusted by incorporating the correct value of capacitve reactance between the base of the reflector and the groundplane (radial wire). Similarly, the reflector will be short for the

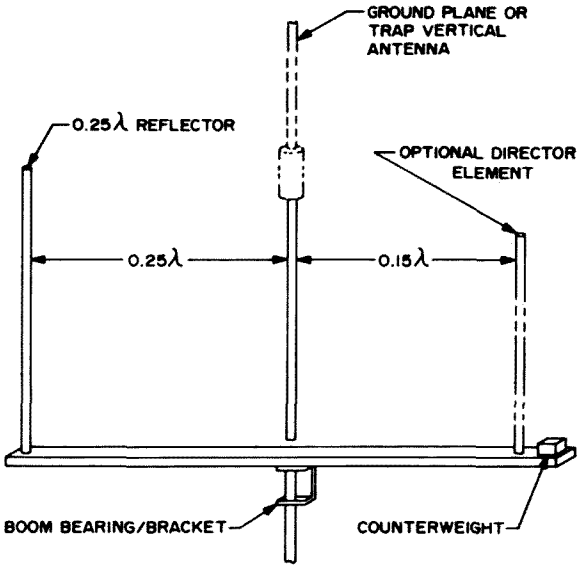


Fig. 3. Rotatable reflector for vertical antenna.

lower frequency band, with capacitive reactance which can be tuned with a series inductance.

The 3/8th wave reflector for 14/7 MHz will be approximately 24 feet high; probably the practical maximum for most installations. However the principle can be applied for 7 and 3.5 MHz where space permits, and strong enough material is used for the 50 foot height.

A 3/8th wave reflector for 28 MHz can be resonated with a series inductance on 14 MHz. Since the reflector length is about 12 ft, it can be resonated both on 21 and 28 MHz with different values of series capacitance, permitting triband operation with a single parasitic element. Figure 4 illustrates the triband reflector, using two relays to insert the appropriate values of capacitance or inductance. Omnidirection is obtained by switching to one of the bands not being used.

In all cases the 3/8th wavelength reflector will require a compromise in spacing from the antenna. 0.25 wavelength at the highest frequency is recommended. This will result in 0.125 spacing at half frequency with inductive loading, and less than optimum gain. About 3 to 4 dB gain should be attainable with careful adjustment. In the case of the triband version, spacing at 21 MHz will be about 0.18 wavelength when the reflector is spaced 8 feet from the antenna for 0.25 wave spacing at 28 MHz. A gain of 5 dB can be achieved on both 28 and 21 MHz.

It should be noted, however, that the closer spacing on the lower bands will have more effect on the antenna impedance, matching, and transmission line SWR.

For the lower frequency bands of 7 and 3.5 MHz, a more compact single reflector may be constructed utilizing the same trap principle applied to multi-band vertical antennas. The reflector is split into two sections, insulated from each other. The lower section is made a resonant length for the higher frequency band (7 MHz). A parallel tuned circuit is connected between the two sections, and resonated to the higher frequency band to function as a high impedance at this frequency. The upper section is adjusted to a length that, in conjunction with the lower section and inductance of the tuned circuit, will function as a tuned reflector at the lower frequency (3.5 MHz).

Figure 5 shows a typical trap assembly which may be made from 2½ in. diameter standard coil stock. The parallel capacitor is a mica type, rated at 2,500V. Resonance is accomplished by removing coil turns while checking with a grid-dip meter, until the tuned circuit is adjusted to the middle of the 7 MHz band.

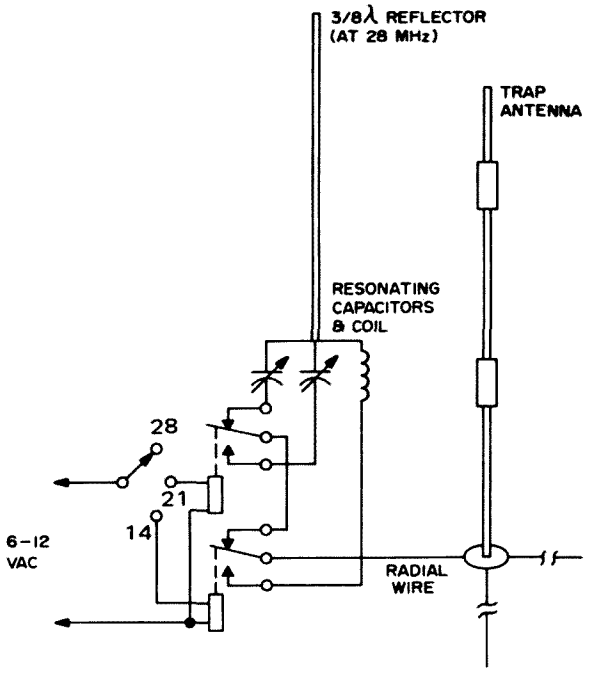


Fig. 4. 3/8th wave reflector for tri-band operation.

Appropriate values for a 7 MHz trap are: Capacitor – 50 pF. Inductance – 9 microhenrys.

Using Barker and Williamson type 3905-1 coil stock, approximately 18 turns will be required.

The trap-type reflector should also be spaced 0.25 wavelength at the higher frequency (7 MHz), from the antenna.

Construction

Previously I mentioned that parasitic elements could be inexpensively fabricated from readily available material. My source of such material is the "do-it-yourself" aluminum rack of the better hardware stores. Practically all such stores carry a supply of aluminum tubing of various diameters and lengths; the larger the store, the better the variety.

For handy reference the following table lists the standard sizes of aluminum stock which are distributed for consumer use, and are suitable for construction of parasitic elements.

Type	Outer Diameter	Wall Thickness	Length
Solid rod	3/8 in.		72 and 96 in.
Round tube	5/8 in.	0.093 in.	72 and 96 in.
Round tube	3/4 in.	0.055 in.	72 and 96 in.
Round tube	7/8 in.	0.055 in.	72 and 96 in.
Round tube	1.0 in.	0.055 in.	72 and 96 in.
Round tube	1 1/4 in.	0.055 in.	72 and 96 in.
Square stock	1 x 1 in.	0.062 in.	72 and 96 in.

The 96 in. lengths are convenient for 28 MHz use. For other bands it will be necessary to assemble elements from two or more telescoping sections. Diameters listed above that provide snug telesocping fits are as follows:

3/8 in. OD rod into 5/8 in. OD tube
5/8 in. OD tube into 3/4 in. OD tube
3/4 in. OD tube into 7/8 in. OD tube
7/8 in. OD tube into 1 in. OD tube

I assemble two telescoping sections by cutting a 1½ in. long, lengthwise slit in both walls of the larger diameter of the mating tubing. A stainless steel hose clamp around the slitted end will securely clamp the inner section after adjusting to the total required length.

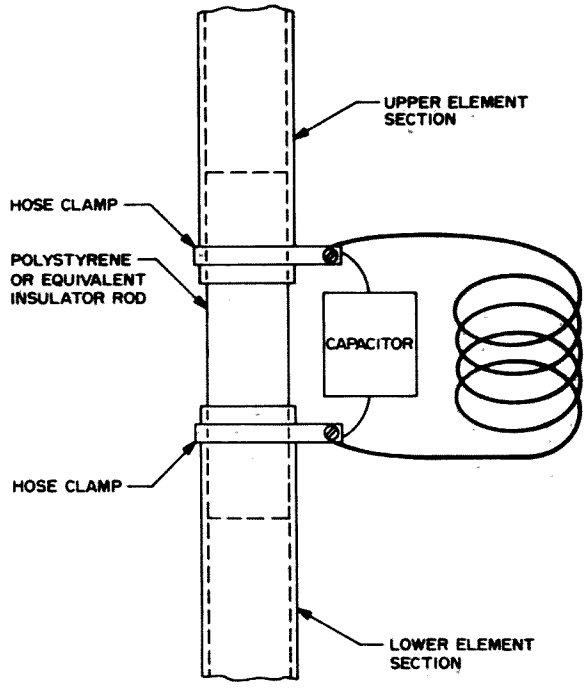


Fig. 5. Trap assembly.

Unfortunately the 1 and 1¼ in. tubing do not fit snugly. Also you may not be lucky in finding all the mating sizes at your local hardware store. In such cases undersized inner sections may be clamped to outer sections using the trick shown in Fig. 6. I cut a 1½ in. lengthwise slot in one side of the outer tubing. At the termination of the slot the tubing is cut crosswise for half of its diameter. The slot must be wide enough that the resulting two ears can be compressed with a suitable size hose clamp to securely grip the inner section. The photograph shows such an assembly for a 15m reflector, using 1 in. and ¾ in. OD tubing.

The consumer-available hardware store tubing is made of a relatively soft alloy.

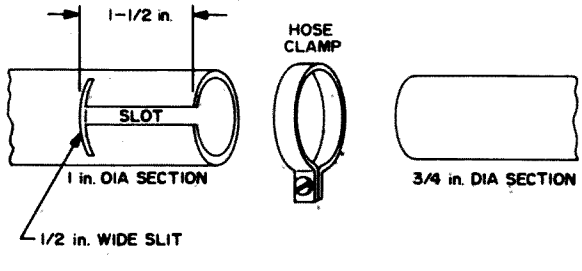
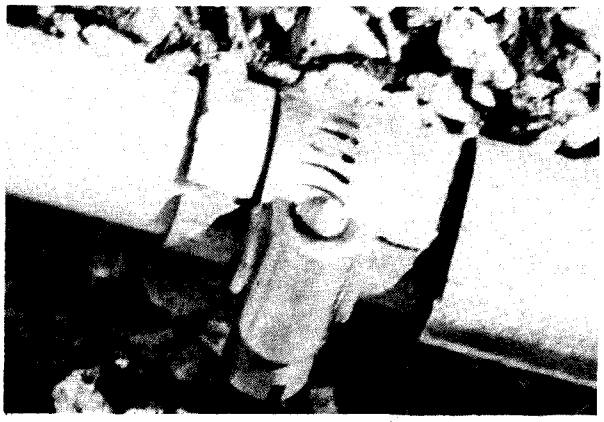
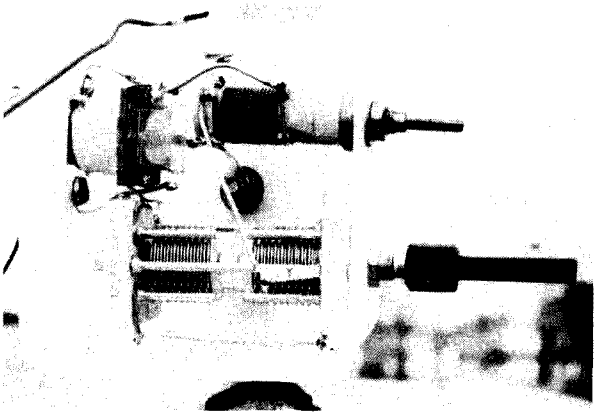


Fig. 6. Method for joining unmatched sections.



Typical joint of unmatched sections of tubing.



Weatherproof tuning box assembly.

While convenient for elements up to 20 ft in height, longer lengths are not recommended without guying. Three telescoping sections of 72 in. lengths is preferable to two of 96 in. Telescoping reinforces and reduces top weight.

Referencing Fig. 3; the rotatable boom can be constructed from a 96 in. length of 1 x 1 in. square stock, joined to a 72 in. length of the same stock with two short sections of 1 in. angle stock, bolted to the square stock to make a reinforced joint. Parasitic elements are made from 5/8 in. lower and 3/8 in. upper sections. The elements may be attached to the boom by drilling a snug fitting hole through both sides of the square stock. The element is inserted through both holes and secured on each side with a small diameter clamp. If the element is to be insulated from the boom for switching purposes, a 2 in. length of 3/8 in *ID* plastic hose or tubing should be slipped over the lower end of the element. The holes in the boom will have to be increased to accept the larger diameter of the insulating sleeve.

Weatherproof housings for accommodating relays, coils and capacitors are also available from your neighborhood hardware store. These are better known as "freezer boxes," and are made from soft polyethelyne material. The square ½ and 1 pint sizes are most suitable for protecting antenna components. The soft material compresses under hardware, forming a natural moisture-tight gasket for mounting and terminal screws.

Figure 7 illustrates a typical installation, with a DPDT relay switching a reflector tuning inductance or capacitor. The mast mounting clamp shown also serves as the electrical connection to the reflector element. The lid of the box is attached after assembly and the joint sealed with polystyrene cement. Alternatively the joint may be covered with a couple of layers of plastic insulating tape.

Conclusions

I said at the beginning that this was an idea-provoking article. Obviously it requires complementary imagination for the individual to suit his own requirements. The fellow with a vertical mounted on a roof peak will be hard put to install multiple reflectors. But a short boom (even of wood) will enable him to install a 28 or 21 MHz reflector.

Some of the techniques suggested may be combined. For example, the 3/8th wave

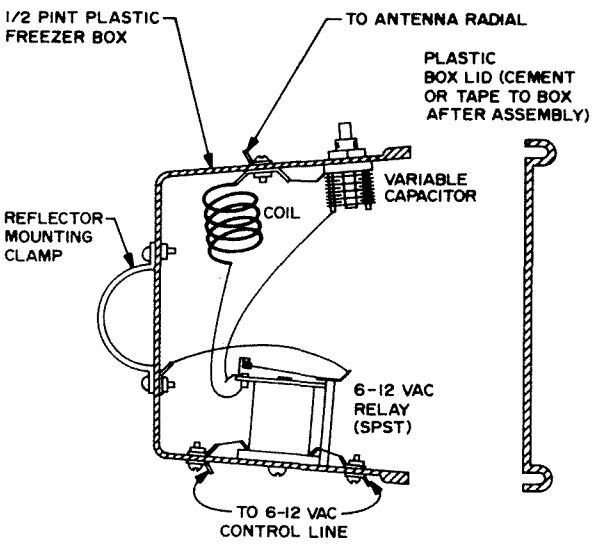


Fig. 7. Typical weatherproof box assembly for reflector tuning components.

reflector shown in Fig. 4 can be used with the rotatable boom in Fig. 3.

No formulas for element lengths on various bands have been included, as these are well covered in the regular amateur radio handbooks which should be in every shack . . . for convenience a reference guide is included.

While the hardware store aluminum stock is suggested for most applications, it must be emphasized that for heights exceeding 20 ft, or where severe wind or icing conditions prevail, precautionary measures must be taken to avoid collapse of the rather soft alloy. If in doubt, structural tubing of the 61ST variety, available from large metal supply houses, is the best bet.

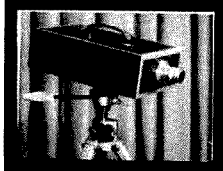
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References:

1. "The Radio Amateur's Handbook" chapter 14, Antennas.
2. "The ARRL Antenna Book" chapter Multi-Element Directive Arrays.
3. "Radio Handbook" Editors and Engineers Ltd., chapter High Frequency Antenna Arrays.
4. "Beam Antenna Handbook" by William I. Orr, W6SAI; Radio Publications, Inc.

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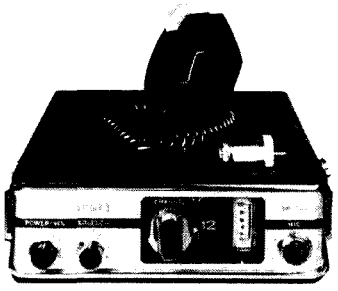
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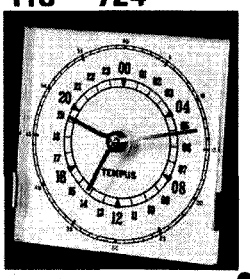
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ACTIVE FILTER DESIGN AND USE PART 1

If you have ever tried to "homebrew" an i-f bandpass filter, or incorporate a variable notch filter or Q-multiplier in your receiver's existing circuitry, you have an idea of many of the problems associated with passive RLC filters. Imagine being able to build a filter not only lossless, but with gain; one capable of matching different input/output impedances, without bulky and inaccurate coils, and all in less space and with better performance than the old iron core, resistance-coupled black box. Active filters, constructed both from transistors and integrated circuits, offer all of the above advantages in addition to ease of altering performance without rewinding coils or utilizing taps.

Figures 1 through 4 show simple filters with specific functions. Digging back into filter design theory for a short while will help us to see how the component values and their placement in the filter is determined. Every filter may be primarily identified by the number of branches containing L or C components. Thus, Figs. 1 through 3 all show two-pole filters of the second order; Fig. 4 a six-pole design. Resistance normally shown in RLC filters as input/output impedance is not considered part of the passive network, although other values of resistance such as that found in the coils and the value of conductance in capacitors, together known as dissipation, cause insertion loss and a degraded response shape at the band edges. Naturally, the tighter the specifications for a filter, the more complex the design must be, five- and six-pole types being common.

The design of passive filters is mostly accomplished with the help of tables containing constant values for the desired components necessary for a particular shape factor. These constant figures are then scaled to real component values. Designing RLC filters "from scratch" is a

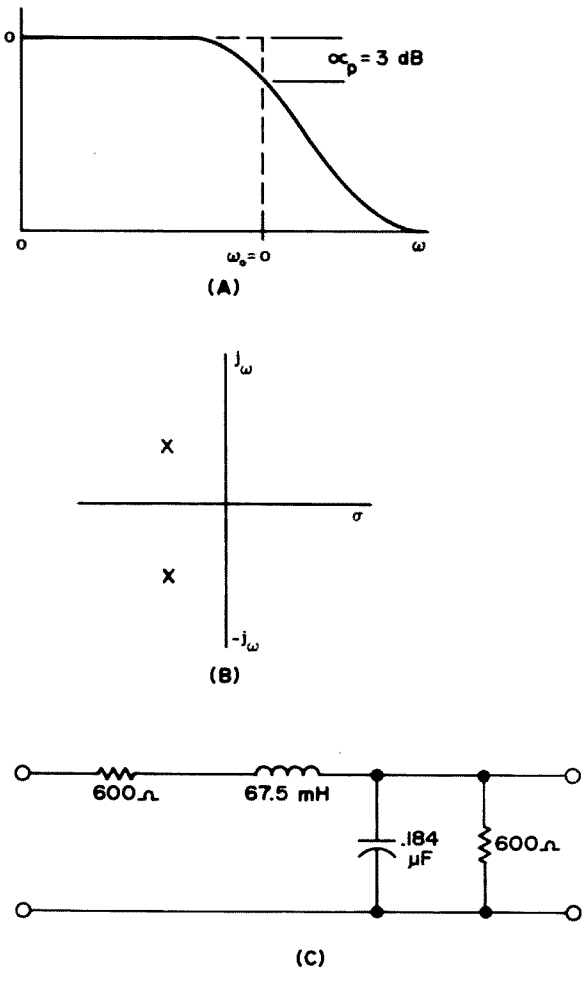


Fig. 1. Low-pass Butterworth (ideal response).

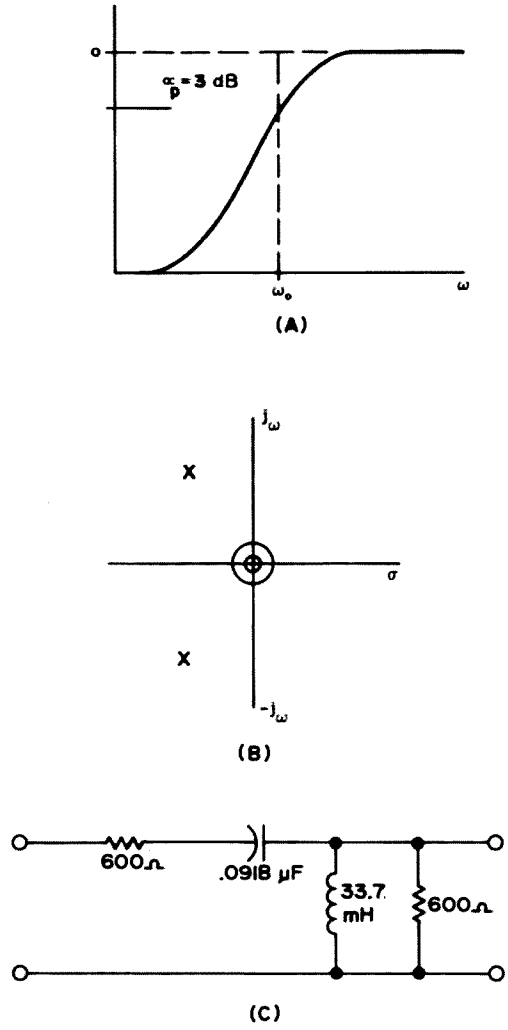


Fig. 2. High-pass filter.

task of great complexity and more suited to computer analysis. By utilizing a complex plane with theoretical component values plotted in complex impedance form, a pole-zero plot of the filter is made. Figures 1A through 4A show the pole-zero plots for four simple filters of different types. Since current/voltage node values are necessary to determine the resulting waveform, this design procedure does not lend itself to amateur filter construction.

Although active filters do away with inductances, in order to simulate the desired response, they must provide the same basic parameters as the coils in the passive filters. The main difference in operation is the ability to increase the Q, or gain of the active filter. In addition, the active filter can be designed so that changing input/output impedances, as a result of tuning internal or external circuits, has little or no effect on filter response. To better understand how filter design is fitted to the desired frequency response, we should begin with basic passive filter types.

In the design of the low-pass filter shown in Fig. 1, we begin by specifying the desired parameters. If we desire a filter with less than 1 dB attenuation from 0 to 2 kHz, and more than 20 dB attenuation above 7 kHz, with 600Ω input/output impedances, we must first determine the bandwidth ratio:

$$y = \frac{7\ \text{kHz}}{2\ \text{kHz}} = 3.5$$

The attenuation ratio of Butterworth response filters is given as:

$$A = \sqrt{1 + \omega^{2n}}$$

Where $\omega = 1$ radian per second, any value of n, or number of poles, will give an atten-

uation ratio equal to $\sqrt{2}$. Naturally, substituting other values of frequency for ω will provide a passband attenuation for Butterworth filters. By computing these various frequencies with different values of n, we can obtain a simulated response shape for filters with various numbers of poles. A two-pole Butterworth filter provides 0.93 dB attenuation at 0.7 of the cutoff frequency of 2 kHz.

As the frequency component of ω becomes higher, the attenuation increases. Similarly, as the number of poles increases, so does the filter attenuation, thus creating a sharper stop-band cutoff. At 3.15 of the cutoff frequency, the stop-band attenuation of a two-pole Butterworth filter approaches 20 dB. A reevaluation of the bandwidth ratios gives:

$$y = \frac{3.15}{0.93} = 3.39$$

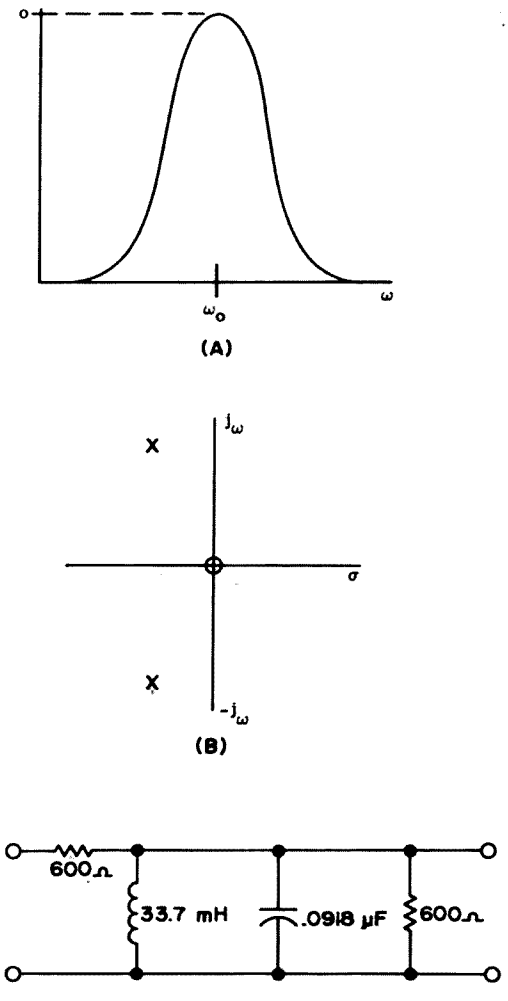


Fig. 3. Bandpass filter.

Since this performance is better than our specified ratio, all requirements can be met with a two-pole Butterworth design. To preclude otherwise necessary computations involving resonant frequencies and cutoff formulas, we can design by means of a normalized prototype. A low-pass prototype is normalized for 1Ω terminations and a cutoff of 1 radian per second. From these values, as shown in Fig. 5, the resistances/impedances and cutoff frequency must be altered to fit our specifications. By means of impedance scaling, we can alter the resistances to allow the filter to operate between terminations of any value. Impedance scaling does not affect filter response, and is accomplished by simply multiplying

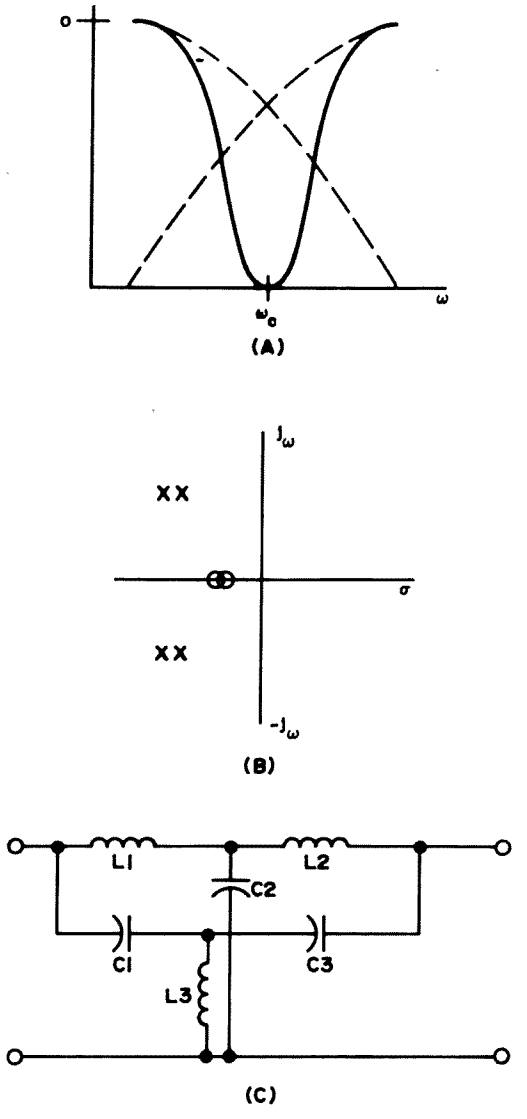
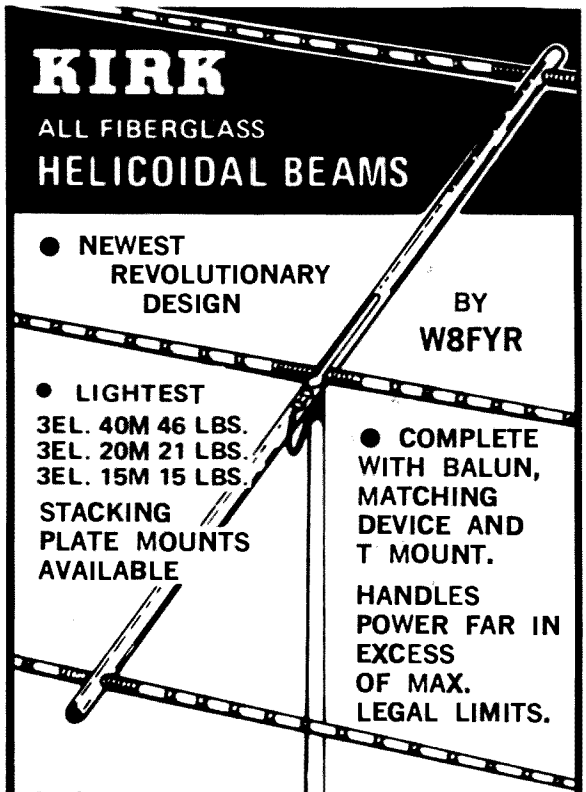


Fig. 4. Bandstop filter.



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all resistances by the desired impedance value, 600Ω in this case. In order to adapt the normalized cutoff frequency to 2 kHz, we employ frequency scaling. Frequency scaling leaves all impedances unchanged but applies a constant to the reactive elements. In scaling the inductance to the required filter value, the following formula is used:

$$L' = \left(\frac{R'}{R}\right)\left(\frac{\omega}{\omega'}\right) L$$

Where the primes denote values after impedance scaling.

Substituting the filter values in this formula gives an inductance constant of:

$$= \frac{(600)\quad(1)}{(1)\ (2\pi \times 2\text{x}10^3)}\ L$$

$$= 47.71\text{Lx}10^{-3}$$

This computed value is the inductance constant in millihenrys. Applying this constant to the prototype gives:

$$(47.7\text{x}10^{-3})\,(1.414) = 67.5\ \text{mH}$$

In scaling the capacitance to the required filter value, the following formula is used:

$$C' = \left(\frac{R}{R'}\right)\left(\frac{\omega'}{\omega}\right) C$$

Substituting the filter values in this formula gives a capacitance constant of:

$$= \frac{(1)\quad(1)}{(600)\ (2\pi \times 2\text{x}10^3)}\ C$$

$$= 0.13\text{Cx}10^{-6}$$

This computed value is the capacitance constant in microfarads. Applying the constant to the prototype gives:

$$(0.13\text{x}10^{-6})\,(1.414) = 0.184\ \mu\text{F}$$

The completed filter is shown in Fig. 1C.

Highpass filter design is simplified to the extent that the response requirements can be applied to low-pass filters by inversion of the high-pass requirements. Thus, if we change the positions of the inductor and

capacitor in the low-pass filter just completed, and replace the element values by their reciprocals, we have a prototype for the high-pass filter. By utilizing the same specifications, the low-pass response can be used as high-pass response by allowing the attenuation to remain as is and treating the frequencies as reciprocals. Figure 6 shows the resulting prototype for specifications similar to the low-pass filter, and Fig. 2C gives the end values.

Normal bandpass filters are symmetrical about a center frequency. Figure 7 shows the bandpass response with shape parameters. Once again the design process is simplified by utilizing a suitable low-pass design. If the value of Q is correct, the bandwidth will be the same for the low-pass and bandpass filter. The required value of Q is given as

$$Q_C = \frac{f_o}{B_3}$$

If, for simplicity, we use the original low-pass requirements, we obtain a value of Q_C:

$$Q_C = \frac{1 \times 10^3}{2 \times 10^3} = 0.5$$

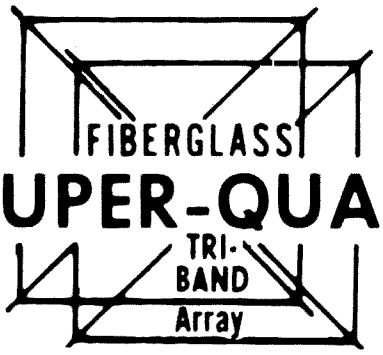
This low value of Q is not typical for a bandpass filter, but is due to the simple requirements on the original low-pass filter and serves to show the necessary calculations.

Having chosen a suitable low-pass prototype, it must be frequency scaled to the cutoff frequency ω_C:

$$\omega_C = \frac{1}{Q_C} = \frac{1}{0.5} = 2$$

Due to the fact that the bandpass filter will be resonated at $\omega_O = 1$, the LC components must have reciprocal numbers. Referring to the calculations for the high-pass filter, it will be noted that the prototype element values for this filter were also reciprocals of the low-pass elements. In designing the high-pass filter, we need only transform the values of the low and high-pass filters. The cutoff frequency (the highest frequency at which maximum attenuation occurs in the passband) of ω_C in the low-pass filter becomes f_2 (Fig. 7) of

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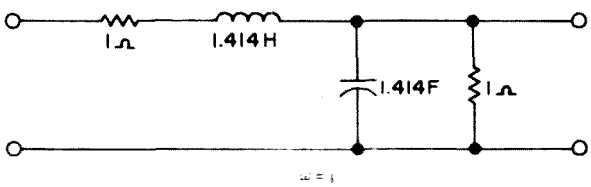


Fig. 5. Low-pass filter prototype.

the bandpass waveform. Similarly, the cutoff frequency of ω_c for the high-pass filter becomes f_1 of the bandpass waveform. In order to maximize the waveform at f_0, we need the least amount of attenuation at this frequency. The simple bandpass of Fig. 3C will be recognized as nothing more than a parallel resonant circuit at f_0. To increase the attenuation on either side of f_0 (narrow the passband), we must either increase the gain or the Q. When using RLC circuits, we can only decrease R as far as possible and increase Q to maximum. As the frequency of interest becomes lower, higher values of Q become increasingly more difficult to achieve.

In order to achieve a smaller bandwidth in passive circuits, we must increase the number of filter sections used. When such an increase is necessary, the insertion loss is raised. Designing with active RC filters solves these problems by first of all removing the inductance. This solves the problem of stray coil capacitance, low Q at low frequencies, and mutual coupling between coils.

The bandstop filter of Fig. 4 can also be considered as a combination of the low-pass and high-pass designs, with the transformation utilizing the reciprocals of the bandwidth ratios used for the bandpass design. If we remove L_2 and C_1 from the design of Fig. 4C, we are left with a low-pass filter and a high-pass filter. As noted, transformations of an adequate low-pass design are possible; however, to

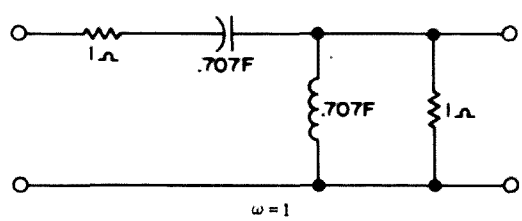


Fig. 6. High-pass filter prototype.

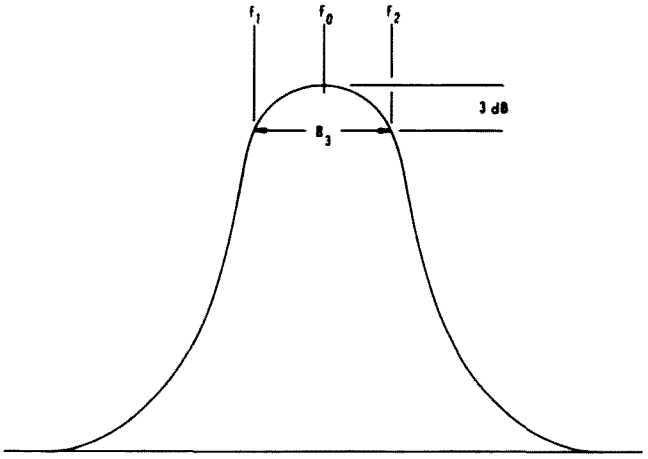


Fig. 7. Bandpass response parameters.

preclude degradation of performance, additional measures are sometimes necessary. In the bandstop design we have paralleled a high-pass and a low-pass filter. Once the input and output terminals of these filters are common, the impedance value of the original filters is no longer 600Ω. Consequently, the response shape of the filter is nearly unrecognizable. To prohibit loading of the circuit, each filter must have a high impedance in that portion of the circuit which produces an overlapping response with the other filter. Otherwise, the best response that could be expected would appear like the dotted line in Fig. 4A. Inserting a component presenting a high impedance in the series branch of the input or output of each network will serve to separate the filter responses. In the case of the low-pass section, we already have an inductor in the series branch of the input, so another coil is added to the output branch. In the high-pass section, the output branch is already coupled by a capacitor, so we add a capacitor to the series input branch.

Since we will be working with amplifier stages in the design of active filters, the same requirements to asssure stable operation at needed gain are valid. Consequently, the first parameter to be specified for an active filter should be necessary gain. Unfortunately, we cannot simply say a gain of 10 dB is necessary between input and output terminals, as we might be able to do with a normal amplifier stage. Because we have removed the inductors from the passive network, we must substitute a method of obtaining complex values for poles and zeros in order to simulate the required waveform. Phase shifts become more important and feedback is necessary to match impedance, stabilize the filter, increase gain, or a combination of these. As in the design of any circuit, tradeoffs must be made for optimum operation. The overall active network exhibits a value of sensitivity which affects its operation. Networks employing positive feedback are subject to oscillation, which might be created by element variations in a Q-sensitive circuit. Negative feedback tends to decrease the gain to unity, but nearly eliminates the Q sensitivity. Gain is directly related to the input/output impedance ratio. This level may be changed by appropriate resistance; however, the optimum dc current value must not be lowered in the process. Choosing high-gain transistors (minimum beta of 150) will allow maximum circuit alteration to achieve the desired response without making the circuit unstable.

Figure 8 shows a two-pole active filter incorporating positive feedback. In addition to the fact that C1 provides positive signal feedback to the first amplifier, it also acts as a complex zero function without a direct ground reference. Consequently, a change in device parameters caused by temperature or impedance may allow this "floating" zero function to alter its position in the frequency plane, thus distorting the desired filter waveshape. If we consider Amplifiers A1 and A2 as transistor stages, Fig. 8 would show them them connected in a common emitter configuration. However, changing the output points of each stage to the emitter will provide a network with unity gain, low Q and freedom from

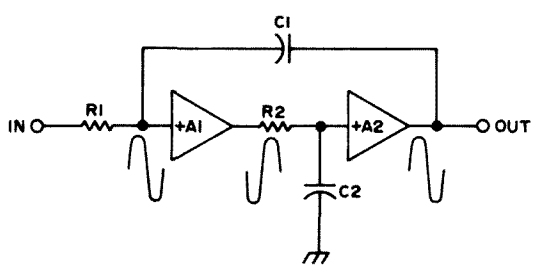


Fig. 8. Active filter with positive feedback.

possible oscillation. In such a configuration, a large ratio of component values will be required and the source must be a current amplifier.

Figure 9 shows a high-gain operational amplifier utilizing a twin-tee network to provide negative feedback. This network operates as a bandpass filter, thus requiring high Q and gain. The inherent high gain of the operational amplifier allows the filter shape, or Q, to remain insensitive to changes in amplifier level. The required ratio of network values in this design is low, but the parameters are difficult to adjust due to the number of elements required. Figure 10 shows the same type of active filter using two operational amplifiers. This circuit incorporates resistive damping to preclude operation as an oscillator. A minimum number of components are necessary and the filter adjusts easily. A constant-current source assures freedom from impedance loading which might affect the filter response.

An additional advantage of inductorless RC networks is the possibility of temperature compensation. A positive temperature coefficient exhibited by a resistor can be offset by a negative temperature coefficient capacitor.

There is virtually no comparison in physical size between the passive and active networks. This becomes most evident when comparing low frequency filters using large iron core inductors, to integrated circuit networks. The small size is further enhanced due to the fact that shielding and physical separation of components to preclude mutual coupling is of minimum importance in most active filter designs.

Component specification problems are considerably eased without having to worry about coil problems. Depending on the circuitry chosen, Q and bandwidth are varied by either resistors or capacitors. The tolerance of these components is usually within 10% and the capacitors should have reasonably good thermal stability. Active networks utilizing transistors will require biasing resistors in addition to the frequency compensating components. Operational amplifiers will require a minimum of outboard components for frequency compensation. An overall comparison of cost between the passive and active networks is hard to make. At the lower frequencies, the active networks are much cheaper to design and construct due to the cost of heavy inductors used in the LC circuits. At the higher frequencies, cost is somewhat dependent on performance, but there is never a time when cost is prohibitive. Normally, component costs for the active filter more than compensate for the problems and labor required in design and construction of inductor filters.

Performance of the active filters surpasses that of the passive networks at the lower frequencies, and more than equals them at the higher frequencies, all with the main advantage of doing away with the many problems associated with inductors.

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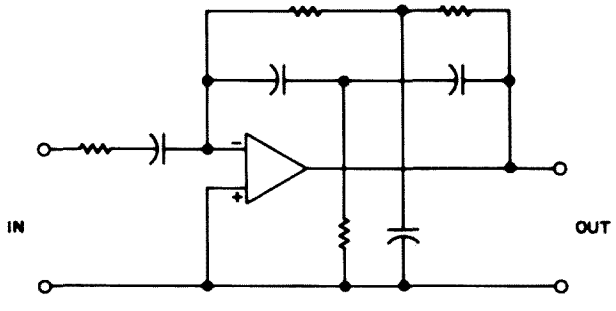


Fig. 9. Twin-tee network provides negative feedback.

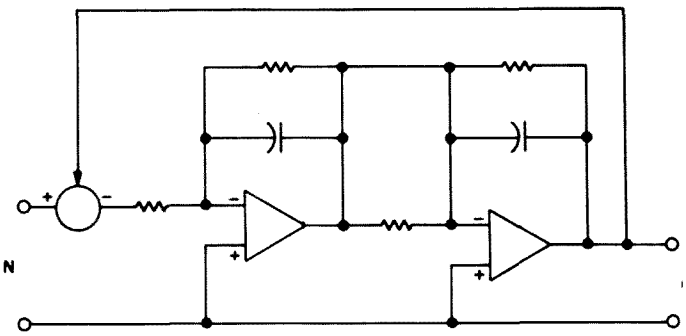


Fig. 10. Resistive damping maintains stability.

References:

Simplified Modern Filter Design. Philip R. Geffe; Rider Publishers

Active Filters: The Road to High Q. Joseph Mittleman; Electronics, May 27, 1968

Active Filters: Positive Results From Negative Feedback. Gunnar Hurtig; Electronics, March 31, 1969

Denys G. Fredrickson W0BMW
3923 East Funston
Wichita KS 67218

ANTENNA PARTY

Or, raise your own antenna and eat the goodies yourself.

As soon as I can afford a tower, I'm going to put up a beam." How often have you heard or said that very thing? Pull up a shovel and sit down and relax a moment, while I describe an economical antenna tower you would be proud to erect.

First, scout around the community for a tall telephone pole . . . then at night . . . no, that won't work. On second thought, go to the telephone or power company and ask if they are planning to take down any poles in the near future. Tell them you would like to have one so you can erect an antenna to assist in disasters or tracking tornadoes – public service, you know. For a small fee they may deliver, dig a hole, and set the pole for you. We have dreamed long enough, so let's get down to copper tacks and go to work.

Prepare the pole before setting it by sawing the top off straight so the saddle (Fig. 4) will bolt on properly. Drill the holes for the saddle and install it. Drill pilot holes alternately on each side of the pole for large lag screws to be installed for steps. You may have a desire to climb it for one reason or another. The view is certainly nice from up there. Be sure the steps are positioned so they will not interfere with the drive shaft.

Set the pole so the top of the saddle is as level as possible. To accomplish this you can eyeball it, use a plumb bob or a level. A 40 or 50 ft pole should be set in the ground approximately 8 ft. Install 5/8 in. lag screws for steps, and now you're ready to do some measuring and locating of components on the pole.

Saddle Construction

To determine the length of U-channel required and how much overhang is needed, one must first determine how far the drive shaft will be from the pole. This will be dependent upon the rotator and mount

position. A piece of 4 or 6 in. iron U-channel may be utilized for the saddle. Cut the end on each side as shown in Fig. 1, and then bend the end down and weld as shown in Fig. 2.



Fig. 1.



Fig. 2.

Obtain two narrow sturdy pulleys and a steel rod for axles. Cut the slots for the sled and pulleys as shown in Fig. 3. Install pulleys in the slots and weld or bolt axles to the underside of the U-channel. Drill a ½ in. hole near the center of the U-channel for lag screwing into the top of the pole.

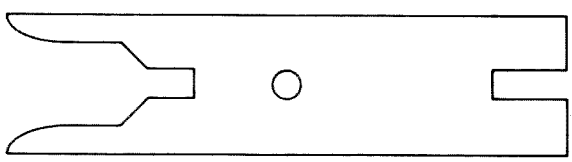


Fig. 3.

Weld a short piece of ¼ in. steel rod next to the pulleys and bend them over the pulleys to prevent the steel cable, when installed, from jumping out of the pulley grooves. Cut and weld a 16 in. piece of U-channel to fit inside of the saddle as shown in Fig. 4, so the center of the sled slot is the same distance from the pole as the center of the rotator drive assembly. The taper of the pole may have to be considered so the drive shaft will be perpendicular when installed. Drill a 5/8 in. hole approximately 6 in. down from the top and another hole approximately 14 in. from the top. Before installing the saddle, make the sled to fit the saddle-sled slot without binding.

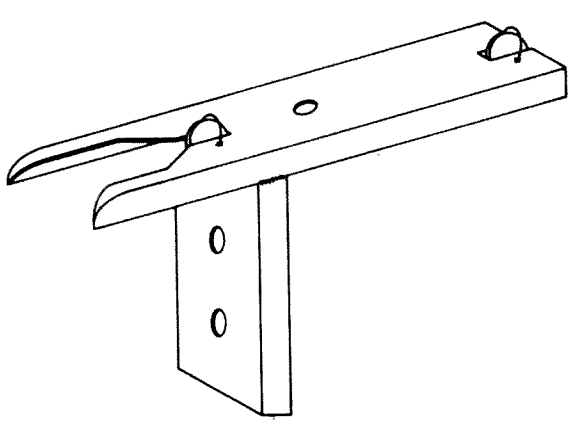


Fig. 4. Saddle assembly.

Sled Construction

The base of the sled is constructed from 1/8 in. steel approximately 7 in. long and approximately as wide as the U-channel. Cut a 2 in. hole near the center and bend the front as shown in Fig. 5. Drill a 3/8 in. hole in the center at each end approximately ½ in. from the edge.

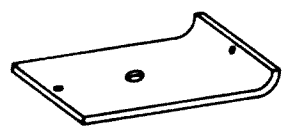


Fig. 5. Sled.

Using 1 in. strap iron, bend it to fit the shape of the slot in the saddle as shown in Fig. 6.. Weld this guide to the bottom of the sled as shown in Fig. 7. Be sure it is positioned so the drive shaft will be vertical.

Visit a salvage yard and purchase a thrust bearing that will slip over a 1¼ in. pipe. The thrust bearing is used to carry the weight of the antenna system on the saddle and not on the rotator, plus allowing ease of rotation. The thrust bearing is not required if these features are not desired. Position the thrust bearing on top of the sled and over the hole so the drive shaft can be inserted through both assemblies. Weld the outer race of the bearing to the sled so that when a load is placed on top of the bearing it will be free to rotate. This completes the sled construction.

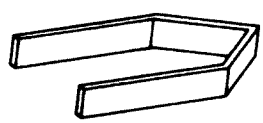


Fig. 6. Guide.

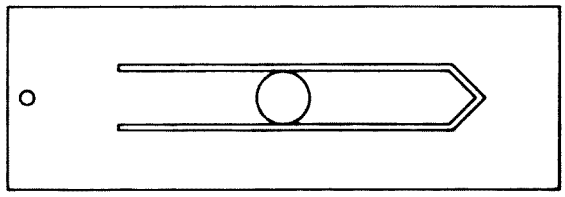


Fig. 7.

Drive Shaft Bracket

The drive shaft L-bracket stabilizes the hinge point during rotation and lowering of the antenna. A 4 in. wide and approximately 12 in. long piece of 1/8 in. steel should be bent into an "L" shape. The hole in the bracket for the drive shaft can be measured and cut after the drive shaft is temporarily installed, to make it easier to locate the exact position for the hole. The drive shaft is then placed through the hole of the bracket. The bracket is positioned just below the hinge point and then lag screws are used to fasten it to the pole. The hinge point cannot be determined until the antenna height above the pole is known. The antenna height above the pole can be 10 ft or greater depending upon weight and wind load of the antenna. The hinge point will be approximately halfway between the antenna and the ground. The length of the lower portion of the 1½ in. drive shaft is from the rotator to the hinge point and the upper portion from the hinge point to the antenna.

Hinge Construction

Cut two pieces of 1½ in. pipe, 24 in. long. Drill a half-inch hole, 3 in. from one end, through each piece. Drill another half-inch hole, 9 in. from the same end. These holes have to be drilled accurately, so half-inch bolts can be inserted through both pieces. It is suggested that when one hole is drilled through each, they be bolted together before drilling the second hole. This will assure alignment of the two pieces. Two similar holes must be drilled in the lower drive shaft and these must be drilled accurately so all three pieces can be bolted together as shown in Fig. 8.

Weld the two pieces to the upper portion of the drive shaft or bolt them together if desired. In either case, keep the lower section bolted together to assure alignment

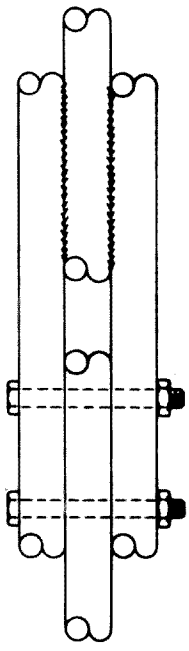


Fig. 8. Hinge assembly.

when completed. It is suggested that a washer be installed to allow ease of removal of the lower drive shaft after the welding operation. Removal of one bolt will allow the drive shaft to hinge on the other bolt. Two bolts are used for added strength.

The upper drive shaft is inserted through the sled assembly, winch installed on the pole, and ¼ in. steel cable run from the winch up over the two pulleys on the saddle and down to the ground, where it is attached to the front of the sled. Insert the lower drive shaft through the center bracket and attach the other end of the drive shaft to the rotator. Hoist the upper drive shaft so the

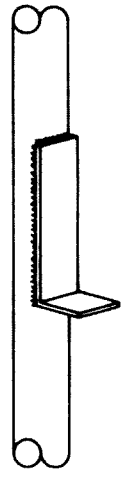
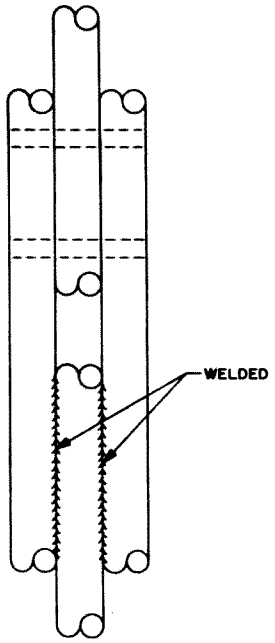
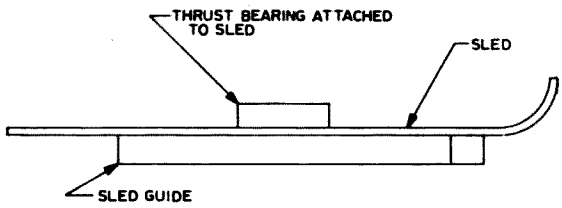


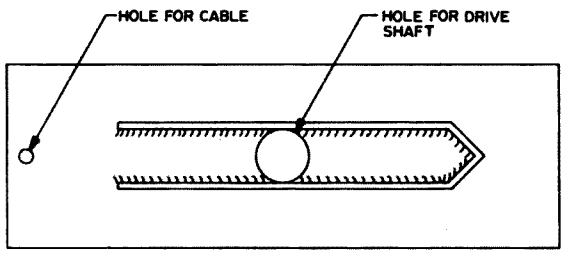
Fig. 9.



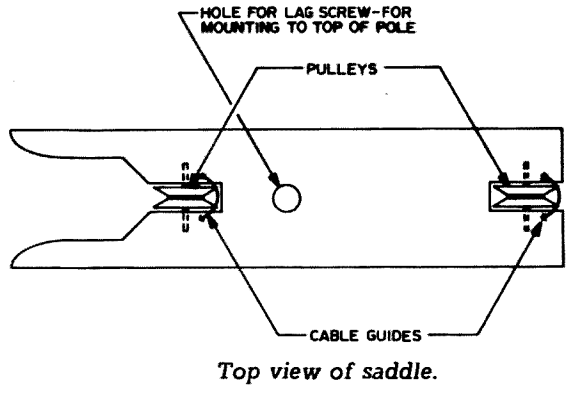
Hinge portion of driveshaft.



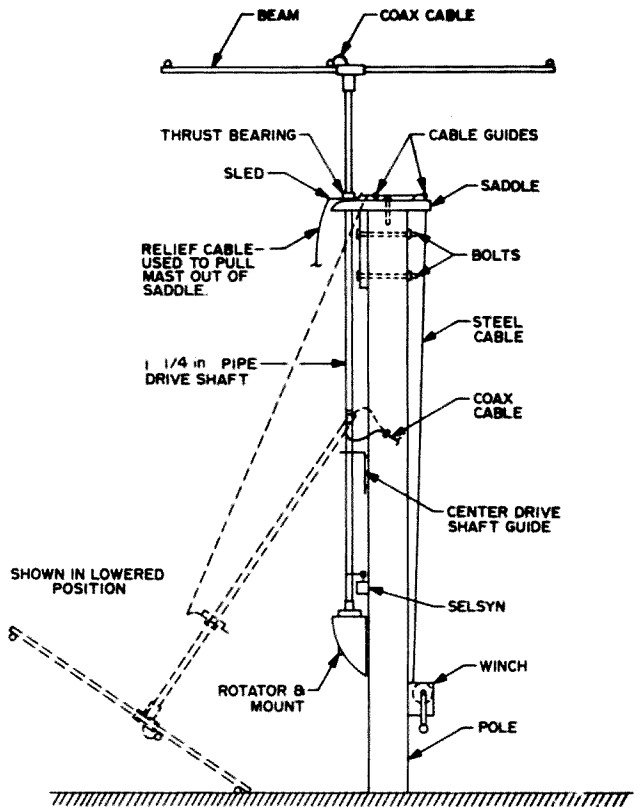
Side view of sled.



Bottom view of sled.



Top view of saddle.

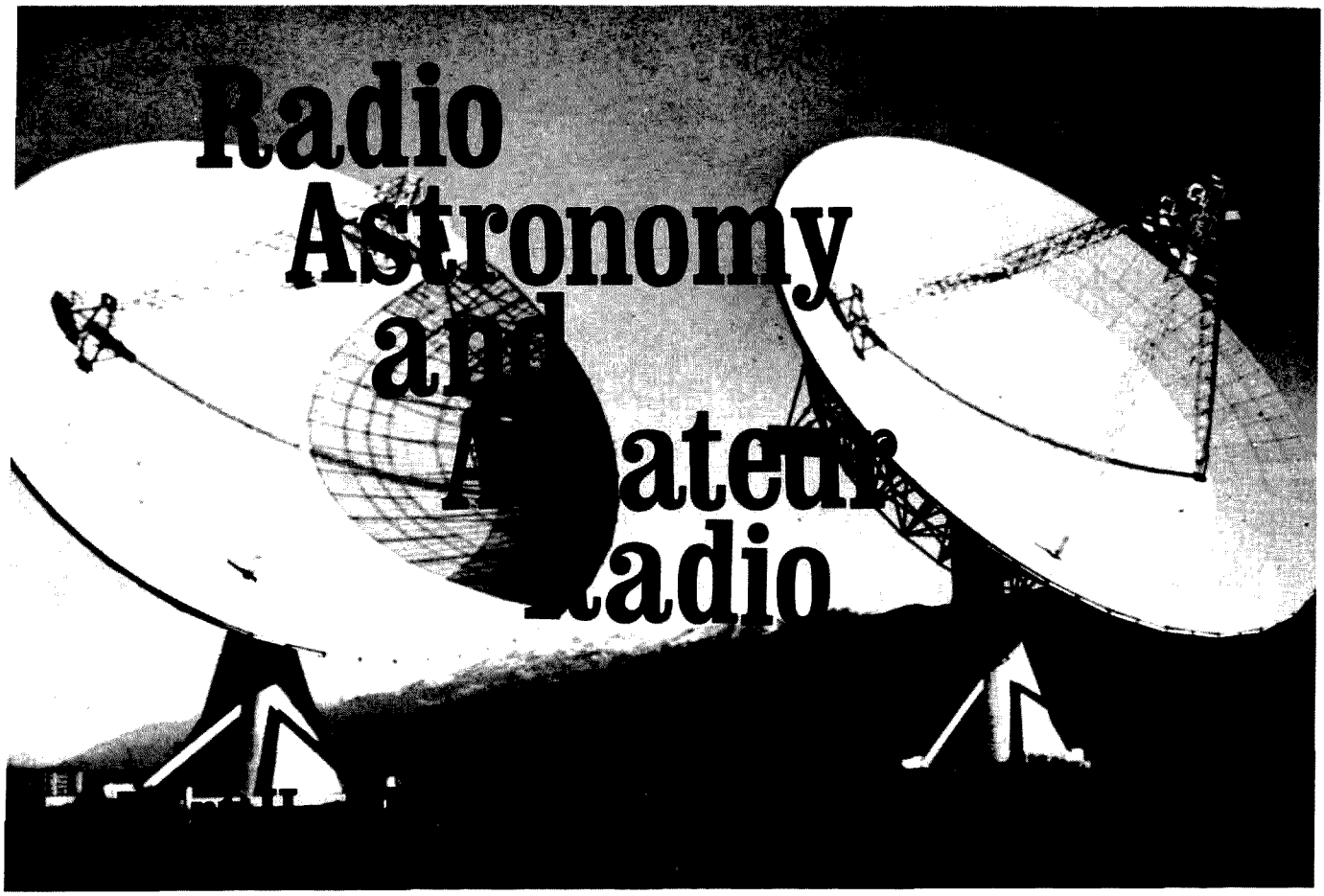


The whole shebang.

Fig. 10.

hinge section can be mated by inserting a bolt. After drive shaft and sled are hoisted to the operating position, install center bracket and mark the pipe even with the top of the thrust bearing. Lower upper section and weld inner race of thrust bearing to the pipe a small fraction of an inch below the mark, so the weight will be carried by the bearing and not the rotator when in operating position. Attach antenna and route cable down center of pipe and out of the hinge. Provide sufficient slack in cable to allow for more than 360° of antenna rotation. A reversing switch can also be installed, or a limit switch, if desired. Be sure to install a good ground system. I have used this type of system for over ten years at two different locations without one speck of trouble. More recently a Cliff Dweller antenna was installed above the TA-33 Tri-band Mosley beam with excellent results. No guy wires clutter up the yard, and antennas can be lowered and raised single-handedly. It is suggested that a piece of strap iron as shown in Fig. 9 be welded to the pipe where the antenna attaches with U-clamps. This will prevent the antenna from rotating on the pipe or slipping down the pipe if it should loosen.

. . .WØBMW



Radio Astronomy and Amateur Radio

Ed. Note: The first half of this two-part series contained figures numbered 1–4. Hence, in this section, which is a logical continuation from Part I, the figures are numbered sequentially from 5 to 8.

The radio spectrum extends up to about 40,000 MHz, and is grouped into seven classifications because of the vast differences throughout the total radio frequency spectrum.

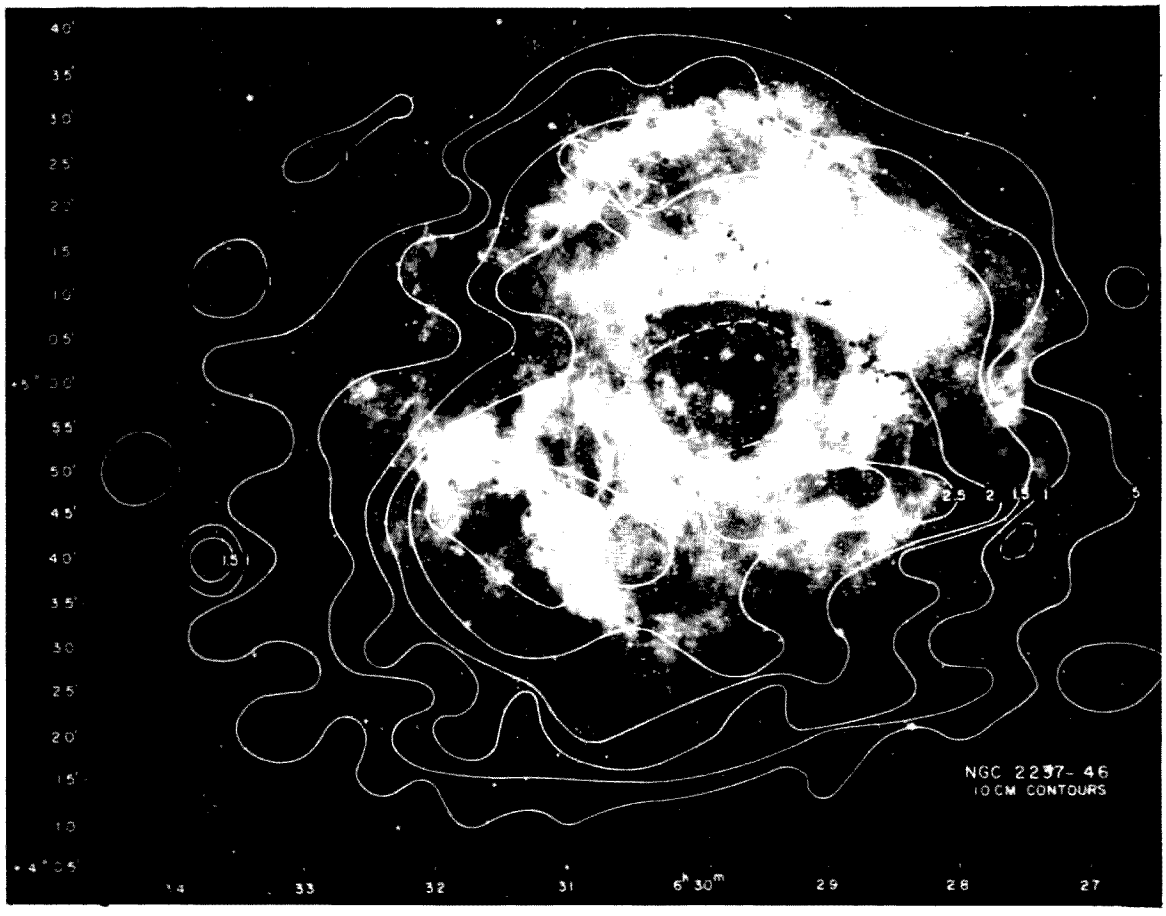
10–30 kHz Very low freq.
30–300 kHz Low freq.
300–3000 kHz Medium freq.
3–30 MHz High freq.
30–300 MHz Very high freq.
300–3000 MHz Ultrahigh freq.
3–30 GHz Superhigh freq.

If the radio spectrum were a yardstick, the first 10 in. would contain 98% of all radio communications used for military, aviation, radar, two-way radio, ship-to-shore, ham radio operations, mobile telephone, AM broadcasting, FM broadcasting, international broadcasting, VHF television, and UHF television broadcasting.

It would seem that the last 25 or 30 in. of the yardstick or 25–30,000 MHz would be the best place for observing with the radio telescope. But at frequencies above 3000 MHz it becomes a major problem to reduce noise coming from the source in space.

While the problem at superhigh frequencies is atmospheric absorption, at lower frequencies the ionosphere reduces the signal level of waves passing through the charged layer. In addition, this layer in the upper atmosphere can cause signals at low angles to skip back into space just as radio signals on the reverse side are bounced back toward the earth.

The upper layers of the atmosphere (Fig. 5) form thick layers or bands of ionized particles when these atoms are excited by ultraviolet energy from the sun. Obviously, while thick bands of ionization are formed during the day this same upper



The Rosette nebula – a radio stellar source observed at the 10 cm wavelength or about 3000 MHz. The white lines outline the radio contours and are superimposed on an optical telescope photograph of the Rosette nebula. Numbers along the base of the photograph are known as right ascension (RA), which together with the declination angle along the left side of the photograph give the astronomer the exact position of the source on the celestial sphere. NGC-2237-46 located in the lower right corner indicates the new general catalog number of the source. This was a list of optical star clusters, nebulae, and galaxies compiled in 1888. The cataloging of sources is a must in order to let astronomers locate sources quickly. This particular nebula is relatively young and hot; notice how the areas of intense radio energy correspond to areas of intense visual light. (National Radio Astronomy Observatory.)

rather than an audio signal varying at an audio rate. This varying dc drives a pen which is set in a movement very similar to a meter movement. A change in voltage causes the pen to swing in the same manner as the needle of a voltmeter.

If the variations of the pen follow each small change of input, the final product will end up being a mass of confusion so some way must be used to smooth out the rate of pen movement. The exact rate depends on the type of observation being made. Normally a capacitor and resistor are placed in the pen circuit to even out the fluctuations. (See Fig. 8.)

Another important stage in the telescope is the noise generator, which provides a calibration source of a known intensity, for plotting relative intensity and actual intensity at the receiver.

Types of Radio Telescopes

Telescopes may be either of the radiometer type or of the interferometer type.

The radiometer is a simple single radio telescope used to observe radio sources much like an optical telescope.

An interferometer consists of two or more antennas which are used in conjunction with each other. If two antennas are used they both feed a single receiver.

The use of two antennas as in Fig. 8 actually increases the effective aperture of the telescope; thus much more resolution can be built into a receiver without making it physically larger.

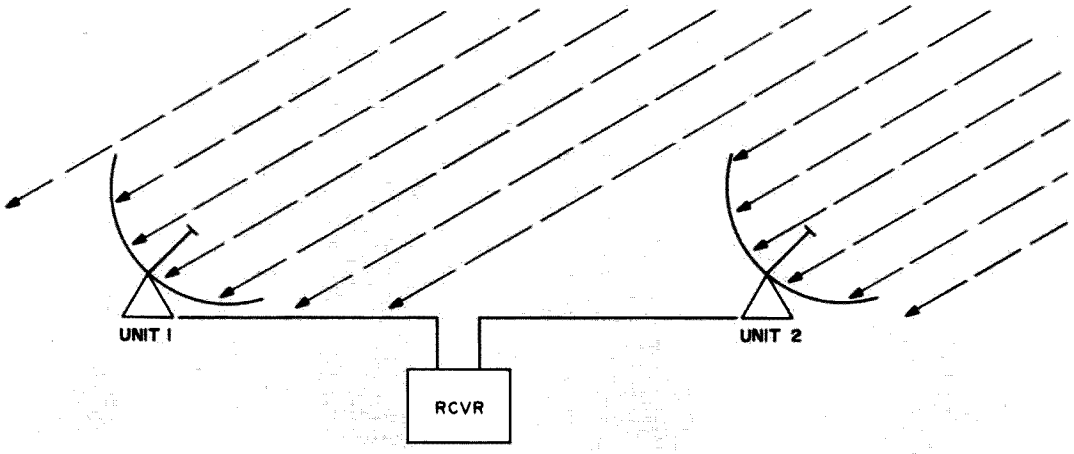


Fig. 8. Energy from space arrives at telescope 2 first, causing a phase differential between the two antennas; this "difference" is useful in determining astronomical data.

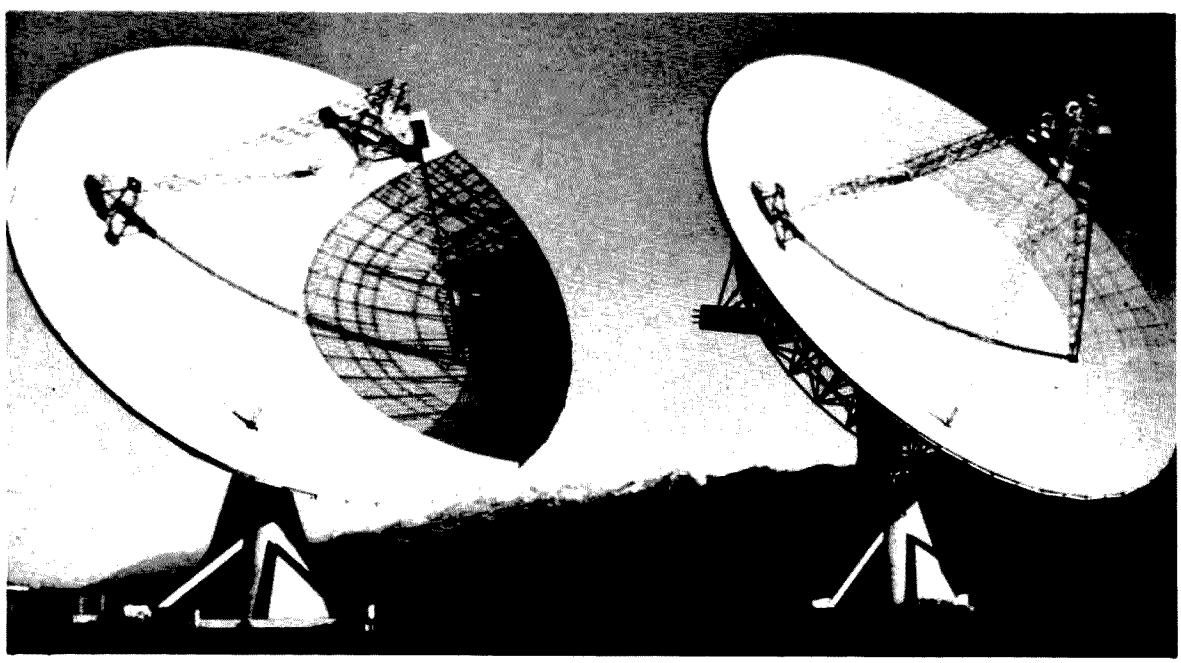
Antennas

One of the most important factors in the performance of a telescope is the antenna. The antenna of a dish type telescope does the exact same job as a mirror of a reflecting-type optical telescope. It gathers energy and focuses it to a specific point.

Parabolic. The dish is not the only antenna being used for radio astronomy; in many cases the dish is the most inefficient antenna which might be selected. For example, because a dish needs to be at least 10 wavelengths in diameter, at wavelengths longer than 20 meters a movable antenna becomes almost impossible even for the professional with unlimited funds.

The dish is a broadband device with a rather flat gain curve over several megahertz. It is important to be broadbanded for most radio astronomy applications. It does no good to have a broad intermediate frequency if the antenna has a sharp gain response.

The higher in frequency one goes with the same size dish antenna the more efficient the antenna will perform. This is because the higher the frequency the shorter the wavelength: The wavelength (λ)



Twin 90 ft telescopes at Owens Valley Observatory operated by the California Institute of Technology through funds provided by the Office of Naval Research. (Office of Naval Research.)

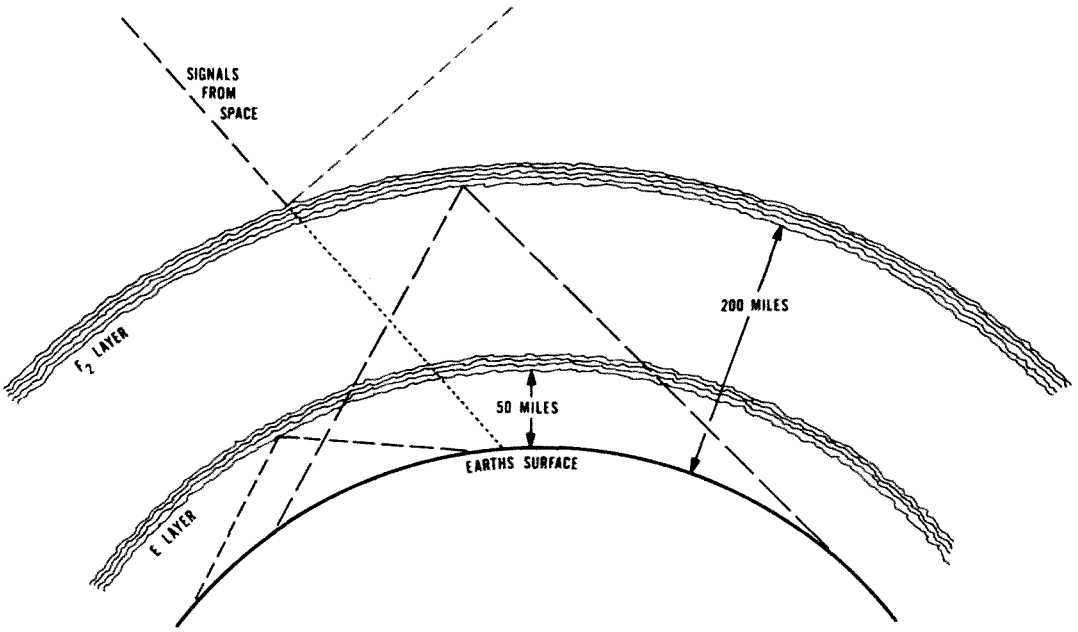


Fig. 5. The E and F ionosphere layers reflect signals from space as well as signals from earth.

atmosphere is transparent to medium and high radio frequencies during the night.

The ionosphere is not one solid layer but consists of a series of layers at different heights above the earth's surface.

At a height of about 70 miles, the first ionized layer (E) exists. The second layer consists of a single layer of ions during the night but splits into two separate layers during the day. The average height of the F layer is 175 miles.

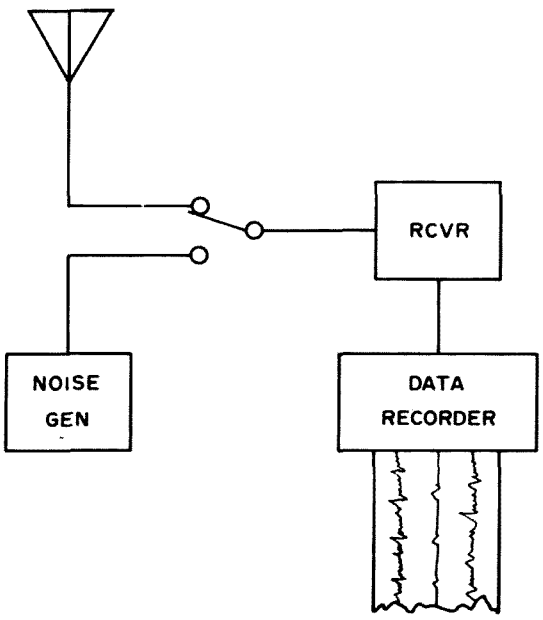


Fig. 6. Simplified data gathering system consists of a noise source, receivers and antenna, and a method for recording the incoming information.

The Basic System

Almost all radio telescopes in use today consist of an antenna, receiver, data recorder, and noise generator for calibration.

Figure 6 shows a block diagram of a simple system.

The receiver operates on the standard superheterodyne principle not too unlike a standard home television set.

An expanded telescope is diagrammed in Fig. 7. Note that the various stages of the receiver portions are displayed in greater detail.

A signal is induced into the antenna and is transferred to the input of the rf amplifier stage via a coaxial transmission line. The rf amplifier is usually a broadband device with a low internal noise and 10–30 dB of overall gain. The most important function of the rf amplifier is to establish a low noise level throughout the system. It is obvious that excess noise generated in this stage will be fed back and amplified along with the desired signal in each of the succeeding amplifier stages of the receiver.

The next stage after the rf amplifier is the mixer. This stage along with the oscillator combine to lower the output frequency to the intermediate frequency.

The oscillator is removed in frequency from the carrier frequency by a difference

of the intermediate frequency. The oscillator can be made to operate either above or below the carrier frequency but always the difference must be that of the intermediate frequency.

This stepdown in frequency is the heart of the superheterodyne principle for it is easier to attain high sensitivity, selectivity, and stability at the lower frequencies than at the higher ones.

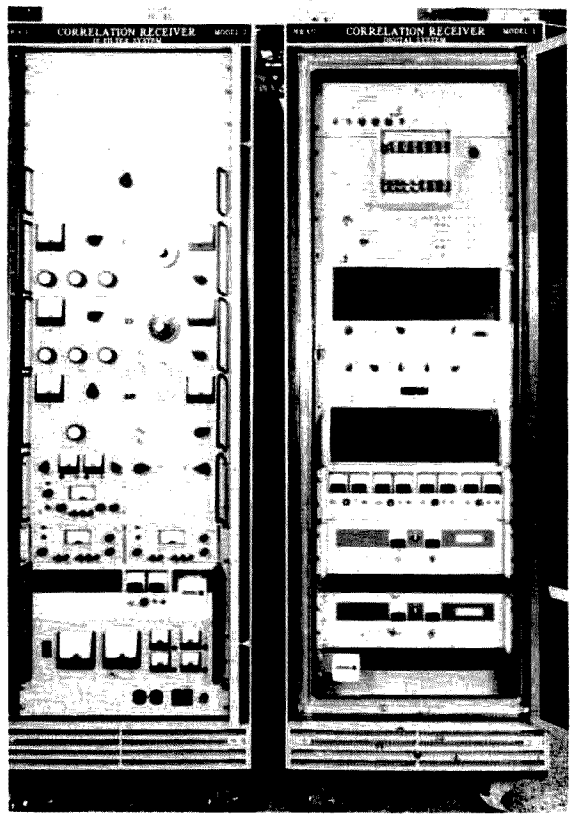
Just as the rf amplifier determines the noise level of the entire receiver, the i-f amplifier determines the sensitivity and selectivity of the entire telescope. The i-f amplifier is usually made up of at least 2 or 3 amplifiers; and 30 to 120 dB in total gain is the norm. The bandwidth depends on the type of signal the observer wishes to receive. If some discrete narrowband signal is being received the bandpass of the i-f amplifier must also be narrow. Such a signal might come from a spacecraft or satellite.

For natural radio noise a wide bandpass must be used, on the order of 3–6 MHz. At lower frequencies it is almost impossible to find 3 MHz with no other man-made radio signals which would interfere with the observation. As a consequence, the radio astronomer must be content with only a few kilohertz of bandpass at frequencies below 100 MHz.

After the i-f stage has amplified the signal and established the receiver's bandpass, the signal is sent to the detector stage, where the i-f is blocked by a diode, leaving only the variations which appeared on the original frequency.

After the detector, the signal is sent to either an audio frequency amplifier if the receiver output is a speaker or a dc amplifier if the final output is to be a pen recorder.

If a pen recorder is used a dc amplifier is needed to convert the signal to a varying dc



This unique receiver was designed and built at the NRAO and is used for receiving spectral lines of elements which fall within the radio spectrum. The i-f amplifier is contained within the rack on the left. The i-f stage is the first stage inside the "shack"; this is because the rf amplifier and mixer stages are mounted out at the antenna. Several narrowband filters are located in the i-f stage to allow for a very accurate determination of frequency. The rack on the left contains the digital switching system, a memory bank, and various power supplies. (National Radio Astronomy Observatory.)

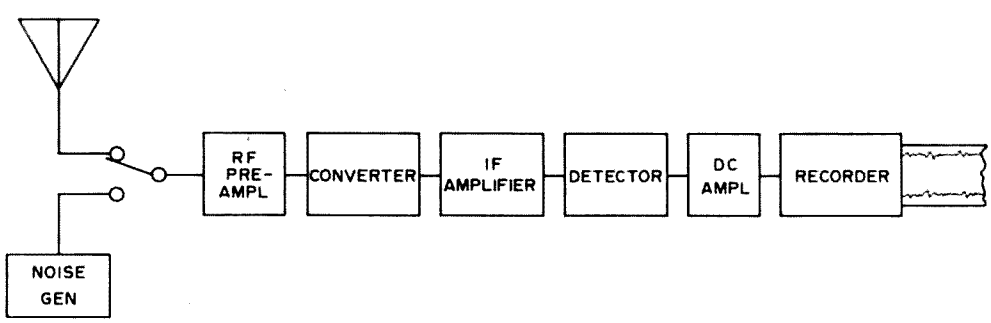


Fig. 7. Block diagram of a complete radio telescope system.

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- Operates from 10 to 15 VDC. Includes 3 precision IC voltage regulators (one for each major circuit function) to prevent interaction and to take care of those wide voltage swings in mobile installations. Can also be used on 110 volts AC with a small 12 volt 1/2 amp power supply. 50 ohm output for remote operation.

COMING SOON: A frequency synthesizer for 45 MHz. receive crystals, a combination transmit and receive synthesizer, a synthesizer with direct output in the 144 and 220 MHz. band, and a whole series of synthesizers to cover from sub-audio to microwave frequencies.

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is equal to the frequency (f) divided by the speed of light (c).

Collinear. The collinear (phased array) antenna is definitely an "up and coming" antenna. The need for phased-array antennas has come about as a result of the need to track high speed missiles at close range, where it becomes impractical to turn the antenna mechanically. Many satellite tracking antennas as well as the ABM radars are of the phased-array type. During the 1950s and 1960s parabolic (and parabolic derivative) antennas were used. The first radar signals bounced off of the moon were made using a phased-array radar antenna.

Phased arrays like the parabolics are broadband antennas. Unlike the parabolic, which must be built to close tolerances, the phased array is not particularly critical.

Yagi Beams. Very high gains can be had with this antenna; however, it has one serious drawback: As the elements are added to achieve more gain, the frequency response is narrowed. This is not a real problem at frequencies below 30 MHz; however, at VHF and higher a yagi with the same gain as a collinear or parabolic would have a bandwidth of less than 1 MHz, which would impose serious limitations on performance. A parallel would be an optical telescope with both ends of the visible light spectrum filtered out.

If one specific narrowband signal were to be observed, such as a weather satellite, a yagi would be a superior antenna because interference several megahertz removed would be partially filtered out by the inefficiency of the yagis at those frequencies.

The yagi itself consists of one driven element and several parasitic elements. A longer element in back of the dipole serves as a reflector. Shorter elements in front of the driven element serve as "directors."

Helix Antennas. A quite popular antenna for telemetry and weather satellite acquisition is the helix. The helix is a compromise antenna. For a given size and cost the helix is slightly less efficient than the other antennas already described. However, it is extremely broadbanded and will receive signals polarized horizontal, vertical, or circular.

In a yagi which is polarized vertical or horizontal (depending on the position of the dipole), a loss of 2 dB occurs when a signal is received which is opposite in polarity from the receiving antenna.

A helix overcomes this loss even if the antenna itself does not have as much total gain as the yagi.

Problems the Amateur Can Work On

In this day of massive government spending what chance has the amateur in making a significant breakthrough? Actually, the chances are fairly good if the ham is willing to put forth some extra effort. Much listening can be done with standard ham gear; most communications receivers that cover 15 meters are capable of receiving noise from Jupiter and the sun and of hearing general galactic noise.

Some of the unknowns are:

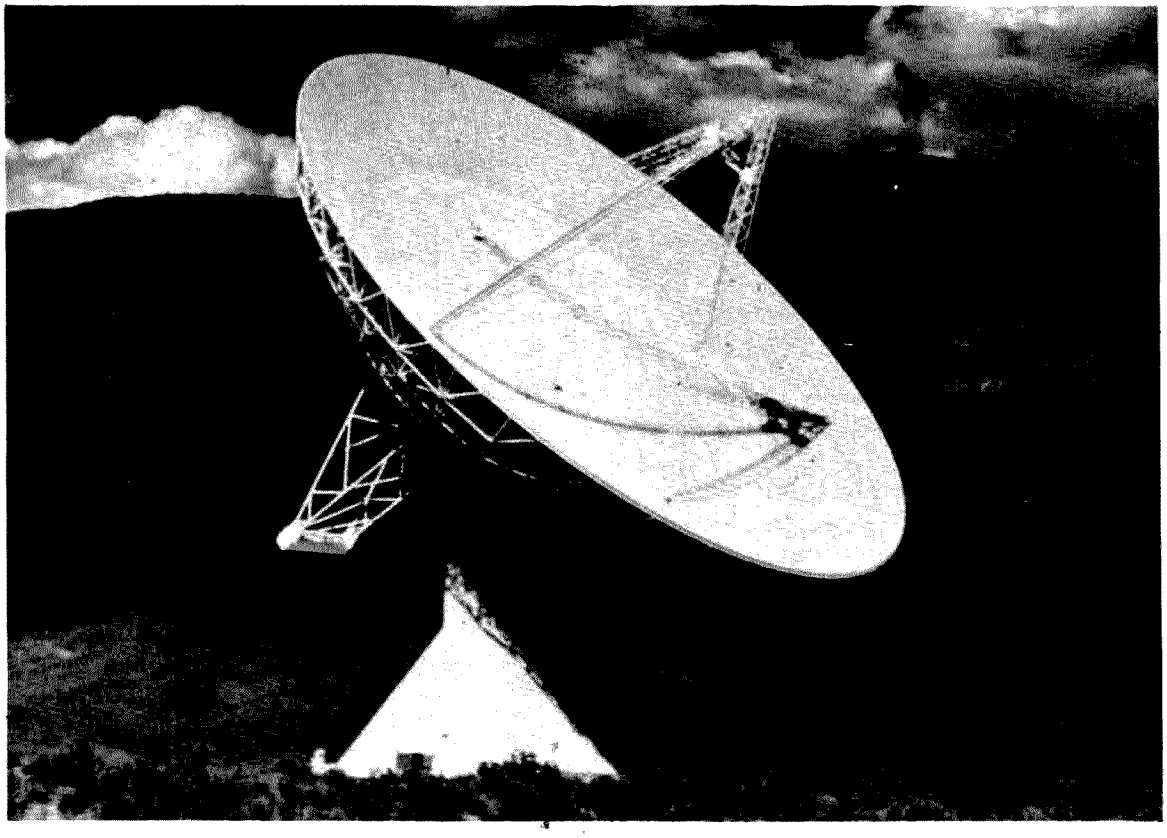
1) How does the planet Jupiter produce its strong radio noise? Does it have something to do with the famous red spot on Jupiter?

2) How and why do sunspots usually appear on the surface of the sun at about the same time that ultraviolet energy causes changes in the ionosphere?

3) The radio observation of sun flares.

These unknowns still exist even though jovian noise, general sun noise, and sun flares may be received with relatively simple equipment; and many books, articles, and papers have been written about the subjects. Maybe, if *you* are not afraid to adventure into the unknown, it might be *you* who discovers the origin of jovian noise or the mechanics of a solar flare. The public library in section 522 has numerous books on astronomy and radio astronomy. You as an individual have the tools and much of the knowledge to again let ham radio make a meaningful contribution to science and technology.

. . . W4ZBE ■



Owens Valley Observatory 130 ft telescope operated by the California Institute of Technology through funds provided by the Office of Naval Research and the National Science Foundation. (Owens Valley Observatory.)

PATENTING YOUR INVENTION

Henry Hunter (the name is a *nom de plume*) is a lawyer and registered patent attorney. He holds degrees in both engineering and law and is a licensed amateur radio operator. **Requests for additional information cannot be answered by the author and should be addressed instead to a registered patent attorney or agent of the inquirer's own selection. See the *Directory of Registered Patent Attorneys and Agents* cited in the bibliography accompanying this article.**

Amateurs have contributed much to the advancement of the radio and electronic arts. Notwithstanding the dominance of research and development in recent years by the technical and scientific staffs of institutions, universities, and large corporations, the independent inventor has not become obsolete or even less effective. Large organizations have the advantage of funds with which to purchase equipment and the pooled talent required to utilize such most effectively, but true inventiveness – which is a more modest term for genius – is born, not bought. When God wishes man to discover more – or utilize one of – His wonders, He does not form a corporation, float a bond issue, or build a laboratory. Instead a child is born: a Marconi, a Morse, a Fleming, an Edison, or a Tesla. Although research groups and large laboratories will probably continue to pour forth discoveries and inventions, not all men of inventive talent will necessarily join their staffs, and individual inventors in small laboratories, basement workshops, and university carrels will also continue to conceive and discover a significant proportion of the inventions of the future.

While large research organizations and laboratories usually have patent counsel on their staffs or on retainer, individual inventors and smaller organizations usually do not. This article is not intended to serve that need, however, but merely to provide some general orientation and answers to certain common, general questions, and to point out the necessity of seeking competent professional advice immediately when needed.

Is Your Invention Patentable?

A United States patent may be obtained by any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement thereof, not known or used by others in this country before his invention or discovery thereof, and not patented or described in any publication in this or any foreign country before his invention or discovery thereof, or more than one year prior to his application.

Patents are not granted for inventions that are useless or inoperable, for the literary content of printed matter, or for methods of doing business. Patents may be obtained, however, for designs and for certain types of plants.

Public use or sale of an invention in this country more than one year before filing a patent application, whether by or with the consent of the inventor or by another person, perhaps an independent inventor of the same idea, or perhaps one who has taken the idea without authority, will bar the grant of a patent. Additionally, use or publication of the invention in this country, before a patent application has been filed, may prevent the inventor from later obtaining foreign patents. Since it usually takes several weeks, at least, to prepare the drawings and specifications of a patent application, if an inventor wishes to apply for a patent on his invention he is usually well advised to consult his patent attorney as soon as possible after first making his invention.

In order that your patent attorney may give you an opinion as to the patentability of your idea and the probable costs of preparing a patent application, it is usually necessary that a preliminary search first be made on the patents previously issued by the United States Patent Office. This search usually takes three to four weeks to complete. Only a registered patent attorney or agent is qualified to render a professional opinion as to the patentability of an invention.

Will A Patent Guarantee a Profit?

A patent is a document issued by the United States granting to an inventor the right to exclude all other persons within the United States from making, using and selling his invention within the scope of the patent claims for 17 years from the date the patent issues. The patentee can manufacture, use, and sell his invention within the United States so long as he does not infringe on someone else's patent (although he can also do these things without a patent). He can sue and recover damages and an injunction against those who infringe his patent. He can also assign all or part of his patent to others or license others to manufacture, use or sell his invention in all or certain parts of the United States. These are the usual ways in which patentees may profit from their invention. A patent is a badge of the inventive ability of the inventor and may afford him a measure of personal satisfaction in addition to whatever monetary reward it may bring to him.

The commercial value of a patent to a patentee is extremely difficult to appraise. Where the inventor is "ahead of his time," the invention may not achieve commercial success for a considerable length of time. Sometimes the invention may have its most successful application in a field of use quite dissimilar from that in which the inventor first sought to market it. Sometimes, too, due to high manufacturing costs, firmly established competition, failure of the public to accept the invention, or for other reasons, the inventor is unable to realize any financial reward from his patent, no matter how ingenious and useful it may be.

The final test of commercial value lies in the market place. Until a patent issues to the inventor, however, or at least until a patent application has been filed with the Patent Office, an inventor who reveals his invention to a prospective purchaser does so at the risk of losing it. An expressly confidential disclosure can reduce this risk, but many manufacturers will refuse to examine an invention revealed to them in confidence for fear of subsequent claims against them in the event that they, themselves, have invented or are working on the same idea. On the other hand, if one to whom an inventor discloses his invention, even in confidence, steals it, the inventor's remedy in the courts may be extremely expensive, time-consuming, and uncertain. If the invention is believed to

have any substantial value, it should be worth protecting by the filing of a patent application at the earliest possible date. The filing of a patent application establishes with the Patent Office a date of invention for the applicant and gives him some practical protection for his claim of priority and exclusive ownership of his invention so that he can thereafter state that there is a "Patent Pending" on his invention and reveal it to others with more security. Consideration should also be given by the inventor to the desirability of filing foreign applications in those countries in which the invention may have commercial value within one year of the United States filing.

There is no objective test of the personal value of a patent. For some, the prestige of having a patented invention can result in advancement or job security. For others, personal satisfaction alone may, or may not, be worth the expense of seeking a patent. This is an individual matter which the inventor alone can decide. A patent will, however, give your invention legal protection, and hence make it a more saleable commodity, but it will not guarantee a sale nor a profit.

Cost of a Patent

First of all, there is no guarantee that the Patent Office will grant you a patent on your idea. If you apply for a patent, your patent attorney will prepare a patent application for you: a technical document containing an oath, a specification precisely and fully describing your invention in certain form, and a number of claims "staking out" your invention. In preparing and prosecuting your patent application your patent attorney is striving to obtain the broadest possible claims for your invention, so as to reduce the risk of some other inventor "inventing around" your invention, and to give you the strongest possible patent. It usually takes upwards of a month or six weeks to properly prepare the application. The Patent Office, after an extensive search of its records, allows the claims or, more frequently, objects to one or more of them as claiming too much. Your patent attorney may then respond by amendment of the application and by argument. This is called prosecution of the application. This process is repeated until the Patent Office decides to take final action, at which time it may either refuse to issue a patent at all or may issue a grant with only those claims which it has decided to allow. Your patent attorney may, if you elect to do so, appeal any rejection first to the Board of Appeals of the Patent Office and then to either the Court of Customs and Patent Appeals or to the United States District Court.

There is an additional proceeding known as an interference in which a patent application can become involved in the Patent Office. This proceeding is held to determine which of two or more applicants for patent, or an applicant and a patentee whose patent has been issued less than one year, is entitled to patent certain claims. While the prosecution of a patent application may take from six months to several years, if an application becomes involved in an interference proceeding the prosecution period may necessarily be extended an additional year or more.

It is thus impossible to foretell how much, in all, it will cost to seek a patent on a particular idea. However, your patent attorney can usually give you an estimate, in advance, of the cost of preparing and filing a patent application on your invention. Also, after the position of the Patent Office on your case is revealed by the first "Office Action," if prosecution is needed he will be able to give an estimate of the cost of preparing and filing a response thereto. The cost of further responses to Office Actions can be similarly estimated by him, in advance, after each Office Action is received. These services, and the charges therefor, are usually spread over several years. Further, you are at liberty to abandon your application at any time, if you should wish to do so.

The Patent Office minimum filing fee for filing a patent application is $65.00, but, depending upon the number and type of claims, can be $100.00 or more. If an assignment is to be recorded at the time of filing the application, the Patent Office requires an additional $20.00 recording fee for this purpose. There is in adition a final fee required by the Patent Office when a patent is issued. This charge varies with the

nature of the case, but usually approximates $124.00 to $135.00. Drawings required to accompany the application must be made by an experienced patent draftsman and cost from $40.00 to $45.00 per sheet. The Patent Office has special requirements which drawings must meet or be rejected and with which only an experienced patent draftsman is familiar. The number of sheets of drawings required will be determined by your patent attorney and depends upon the complexity of the invention and the particular views thereof necessary to supplement the specification.

The fee of the patent attorney for preparing the application depends upon the amount of time which must be spent in preparing the specification and claims and conferring with the patent draftsman plus, if not billed separately, time spent in conference with the inventor relative to the application. Separate statements are customarily rendered for consulations when no application is filed, and for consultations concerning matters not germane to the filing of a United States application.

It might be said that an inventor should be prepared to expend a total of at least $650.00 to $800.00 to file and prosecute through to final Office Action a United States patent application covering a simple mechanical invention, and from $800.00 to $900.00 on a moderately complex mechanical invention or a simple chemical or electrical invention. The cost of seeking a patent in more complex cases increases proportionately. These estimates are in addition to the cost of the usual preliminary patentability search and opinion, which is usually from $100.00 to $200.00, depending upon a number of factors. Of course, if the patent application becomes involved in an interference proceeding or if an appeal is taken, considerably more expense may be involved. All of these quoted figures can be expected to change from time to time, in step with changes in the required government fees and the fees for other kinds of professional services. The expense of filing foreign patent applications depends upon the country and in many cases must include the cost of translations.

Before investing in a patent application and its probable subsequent prosecution, an inventor or his financial backer is almost invariably well advised to obtain the opinion of his patent attorney as to the patentability of the invention, based upon a preliminary search of the Patent Office records made by an experienced patent searcher selected by the patent attorney.

If the inventor wishes to assign an interest in the invention to another person – as, for example, to a financial backer in return for financial assistance in preparing and prosecuting the patent application – such an assignment may be made at the time the patent application is filed, without the necessity of waiting for a patent to issue.

How to Apply for a Patent

Step 1. Reduce your idea to written form, describing it completely in writing and also preparing a simple sketch or sketches to illustrate it.

Step 2. Show and explain your invention to two people whom you trust and who are technically capable of fully understanding the structure and operation of your invention. Have them sign and date a statement to this effect. Keep this.

Step 3. Show your sketches, written description, and any model you may have (though a model is not essential) to a registered patent attorney or agent. This can often be done initially be mail, but it is usually desirable for the proper protection of your invention that he be able to discuss the invention with you directly, in person, before preparing the application. Complete communication relative to the invention is essential to one seeking the broadest possible patent protection thereof. For this reason it is usually best to consult a registered patent attorney or agent in your state in preference to one with whom you can communicate only by mail.

Step 4. If your patent attorney or agent recommends a preliminary patentability search, advance the expense thereof, allow him to obtain such a search from a patent searcher selected by him, and request him to render his opinion thereon.

Only a patent attorney or agent registered by the United States Patent Office is qualified or licensed to give you a professional

opinion as to the patentability of your invention, and registered patent attorneys and agents cannot ethically, and do not, advertise. Registered patent attorneys and agents are subject to the Rules of the United States Patent Office and must conform to the standards of ethical and professional conduct generally applicable to attorneys before the courts of the United States. Further, registered patent attorneys must conform to the Canons of Ethics of their respective Bar Associations.

Step 5. On the basis of examination of the prior patents revealed by the search and the professional opinion of your patent attorney or agent as to the patentability of your invention, you will then be in a position to decide whether or not you wish to file a patent application. If so, your patent attorney or agent will be able to quote you the cost of preparing and filing the drawings, specification, claims, petition and oath which constitute your application for United States Letters Patent on your invention.

Hunter

Publications Relating to Patents and Trademarks

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Guide for Patent Draftsmen, Selected Rules of Practice Relating to Patent Drawings. Catalog No. C 21.14/2:D 78. $.30.

Patent Laws, 1965. Catalog No. C 21.7:965. $.50.

Patents and Inventions, An Information Aid for Inventors, a Step-by-Step Guide to Help the Inventor Decide Whether to Apply for a Patent, Obtain Patent Protection, Promote His Invention. Catalog No. C 21.2:P 27/10/966. $.15

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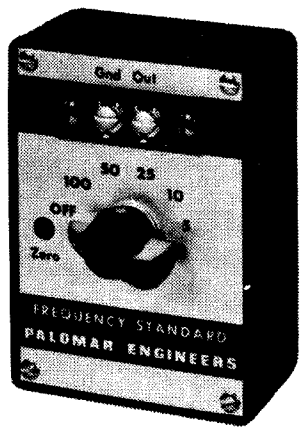
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20 dB BEAMS

In times past in order to make an extended expanded beam with both vertical and horizontal spacing greater than a half wave, I have gone to great trouble and expended lots of time on impedance matching leads from antenna elements to a common fifty ohm point, like with the 32 elements on two meters in the following paragraph.

Two 50 ohm leads from two 2-element yagis brought together makes a 25 ohm point, and then a coaxial quarter wave transformer is needed to bring it back up to fifty ohms again. When these two yagis were matched and phased together, another four elements had to be matched, and then go through the whole affair again. I did this eight times, plus a lot more like 4 and 4 (four times!), then 8 and 8 and then 16 and 16, and finally got a beautiful 32 element job with exciting gain, but *heavy*!

There were so darn many quarter wave transformers, pieces of RG8/U, connectors, etc., that I couldn't even haul my regular mast up with this heavyweight on top. For about one day and night I did get it up on a "jury-rig" out by the barn and started operating and working areas I never knew about before, on strictly ground wave without an opening. The second day a high wind started the mast swaying, and with the weight of all those matching sections and cables it was too much.

Another Wrong Path

You can profit by my mistakes and save *your* time. In any Read and Do program it is easy to make a false start with an idea that looks fine from a distance but soon bogs down in "details, details."

This is what happened with the projected use of the new 300 ohm shielded antenna cable. The idea here was to wire up six small yagis with this cable, join them together at one 50 ohm point, and proceed. Here's what happened.

1. The cable proved particularly difficult to handle. It is quite stiff, and the 300 ohm wires are quite small and get cut off easily. This probably could have been overcome.

2. The problem develops. Most TV antennas are designed for 300 ohm cable, so that is no problem for the TV people, but most amateurs need 50 ohms.

3. The problem gets worse. This new cable is designed to be 300 ohms under *balanced* conditions. When *not* balanced, it no longer is 300 ohms because those two wires are close to the shield. And I certainly wasn't ready to put 432 mhz baluns on 16 small yagis (on each one!) much less on 32 of them if a second 32 element was needed for that last 3 db of gain.

4. It also looked now as though it would need a balun for each cable at the distribution box end also. That did it. Crossing off the use of that nice new shielded 300 ohm cable (anybody for 100 feet at half price?), I went to the 50 ohm unbalanced line box you see detailed later in this article,

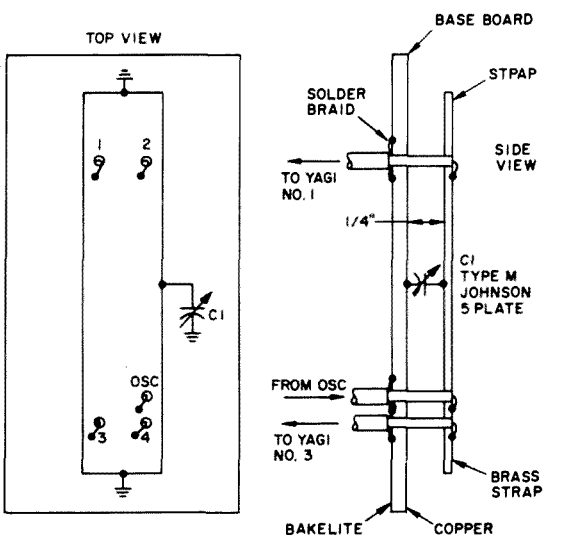


Fig. 1. Strap line rf distribution box.

which not only did a fine job, but removed the limitation of having exactly six, no more and no less, small beams to add together. Several days were lost on *that* one. Be my guest.

A Right Way To Do It

The making up of big beams of an arbitrary number of elements by adding one or more 2 element yagis at a time is accomplished by the use of a distribution box. We will start with the simple strap line type of unit and work on the basic 2, 4, and 8 elements first.

This strap line rf distribution box is shown in **Fig. 1**. With this little gem you can add on an uneven number of 2 element yagis if you want, and have them matched and phased properly. I have just finished checking this. Not that you would normally be attracted by a combination of 3, 5, or 7 small yagis, but there can be times when it might be convenient. This can come about on six or ten meters when you have a two-over-two and want to add another two, as in **Fig. 2**.

Overall Beam Size

As always in vhf beam work, mechanical considerations creep in, especially in a mid-winter blizzard! "If the beam stayed up over the winter, it was too small," is the old-time vhf man's slogan.

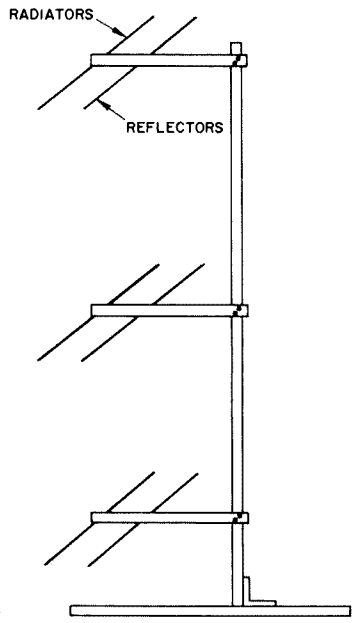


Fig. 2. 3 yagi beam.

Instead of using two-element yagis, you can increase your total power by using more than two elements per yagi. Your inter-element yagi spacing will change then, so watch that item. Some examples will be shown later. I just checked again yesterday for maximum-gain interspacing on 432 with the "standard" 2 element yagis described herein. Maximum gain side spacing radiator tip to tip is 10 inches. Vertical spacing is 18½", CC (center to center of elements).

This outlines the useful capture area and shows the fallacy of the half wave type of spacing, if you want to get the maximum gain from all that aluminum you bought, put together, and are trying to keep way up there.

Details of the "Standard" Two-Element Yagi to Get You Started

I have had good luck with aluminum clothesline material, especially for indoor

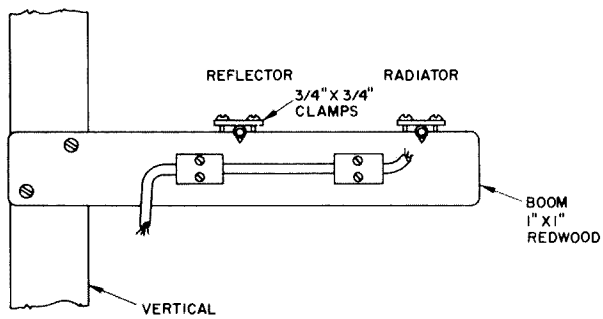


Fig. 3a. Side view, basic 2 element detail.

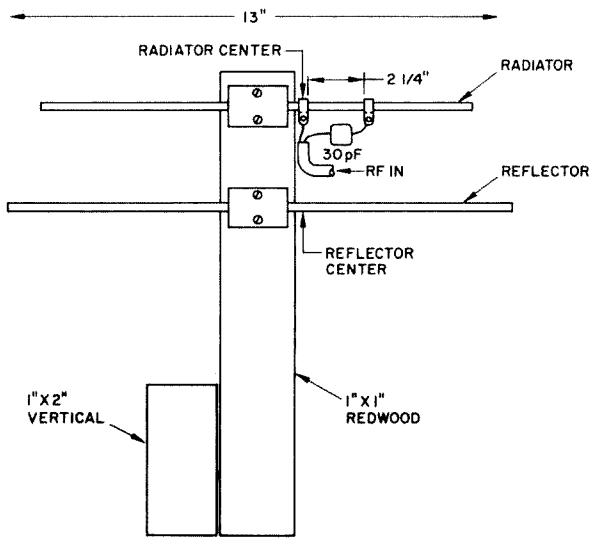
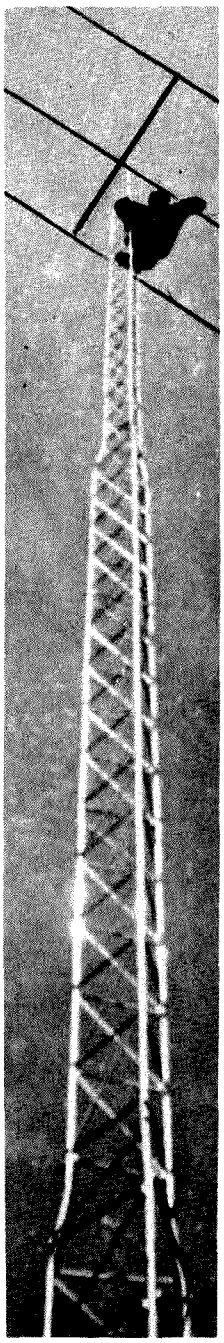


Fig. 3b. Top view, basic 2 element yagi, 432 mhz.

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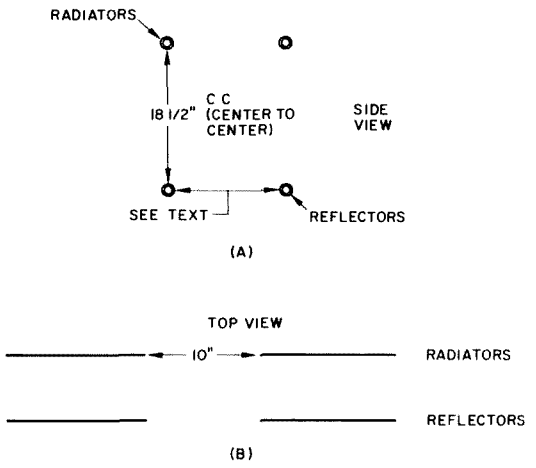


Fig. 4a. Element spacings, basic 2 element yagi.

and mobile work. If you accidently snag it on something, no harm done, just straighten it out and keep calling! It also can be found in almost every hardware store.

Fig. 3a shows some details and the use of the 1 by 1 redwood, also handy in most lumber company stocks.

You can make up lots of linen-base or fiberglass-base bakelite ¾" x ¾" cable and element holders, if you're shooting for the big beam. Remember, as far as booms are concerned, you have a choice between a large number of 2 element yagis or a smaller number of 5 element ones. I hope to find a good balance for you on this matter before I'm through.

Fig. 3b is the top view of the same basic two element job. All this work is done on 432 mhz, which can be translated to other bands by scaling up or down. However, my advice is not to trust this scaling implicity. Check it out with a small antenna range yourself. I even do this on twenty meters, and find that I can light a bulb in an aluminum dipole *five hundred feet* in front of a good 20 meter 3 element beam (the kind I used to make an sell at UHF Resonator Co., Rye, NY). I'll admit there was a good kw behind that beam at the time.

The basic 2 element described is inexpensive, but not "cheap." By the time you're all done and get that still-far-ahead 20 db gain, there will be lots of time and work spent by you.

The joint between the cable, center, C1 and its mechanical support can be improved for outside work. I have snarled this item on

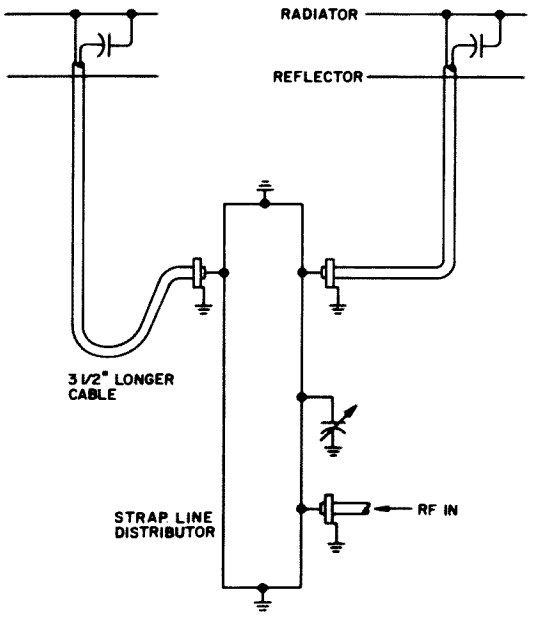


Fig. 5. Unequal cable length set up.

branches and been off the air on top of a mountain more than once! One of those little plastic boxes will do the trick for an enclosure.

The 3 DB Gain of the Second Yagi

Just finished the second one and hooked it up using the half wave distribution box (rf that is) shown in **Fig. 1**. Wow, the old meter sure climbed! Haven't checked yet for sure by the distance method, but it looks like at least 3 db, providing the diode is in a portion of its curve which is reasonably linear.

Figs. 4a and **4b** show the maximum gain spacings found, as mentioned before.

Effect of Unequal Cable Length Feeding the Small Yagis

Using the test setup shown in **Fig.5**, a 3½" cable was added to cable no. 2 to check the effect on the phasing using unequal cable lengths. It worked out exactly as it is supposed to, causing the placement of yagi no. 2 to move forward several inches for maximum gain. The added cable length causes a delay, which is compensated by putting yagi no. 2 nearer the receiver. This points up the desirability of possibly slotting the boom bolt holes to allow a final phase tune-up. So far I do not intend to do this, as I am counting on reasonably equal cable lengths to put the individual yagis in phase, but it is interesting to make it check and be sure of the effect. And then, you might just need it.

The "Parasitic" Colinear Effect

While tuning up a four element job as in **Fig. 5** and comparing gains with and without yagi no. 1 plugged in, I found that the *presence alone* of yagi no. 1, without being attached to anything, caused an increase from 10 to 13 on the meter dial, while plugging it in again jumped the meter to 15 or 16, where it should be for the full four element system. Unplugging it and removing it from the vicinity of the test stand caused the meter to register ten, which it should be for the test set-up involved when using only one yagi. So, for a gain check, remove the whole yagi, not just the plug!

This is the first time I have observed parasitic effects from colinear type elements out on the side. Might be some possibilities there.

"Insertion Loss" of the RF Distribution Box.

This business of insertion loss, a favorite term of precision engineers, only becomes important for you when it is large enough to be measured with your home-brew equipment. Naturally enough, when an engineer is handed a ten or twenty page specification from a military agency, and it says "insertion loss shall not be greater than 5 db," he's got to get crackin' on account of a little item called "Source Inspection" where some Civil Service lad from the military agency involved comes to the plant trying to ship some of those contracted items and says, "What about the insertion loss?"

With the four element beam being worked on, the insertion loss of the rf

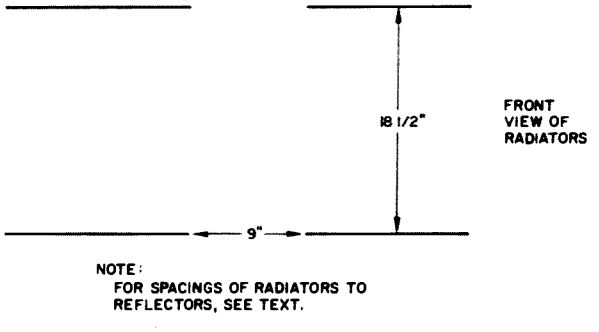


Fig. 6. 8 element spacings.

distribution box being used (**Fig. 1**) cannot be found to any great exactness because it is so small. As a matter of fact, checking the 2 element beam with and without the distribution box, at times it even shows a gain with it. There is a possibility that it is acting like a 'secondary" cavity sometimes used with certain microwave oscillators to stabilize and increase the total Q of the system and raise the output. At any rate, it is certain that good rf distribution boxes can be made for amateur uhf at low cost.

Six and Eight Elements

Just for fun I tried out the gain from the addition of only one 2 element yagi to an existing 4 element beam, and sure enough, it had lots of gain.

A word of caution for indoor, table-top antenna work. If your receiving antenna is too close, (example, only six feet) it is possible that its main cone of reception (10 db points in this case) will be too narrow to see the additional third yagi in question. In this case you will not register the real gain on the meter.

Series Coupling Capacitors and the Strap Line Resonator

The use of the strap line resonator only a quarter of an inch from the ground plane evidently has a further advantage. Looking at **Fig. 1**, series capacitors can be added between the strap line and the ends of each cable center-conductor. However, in all the

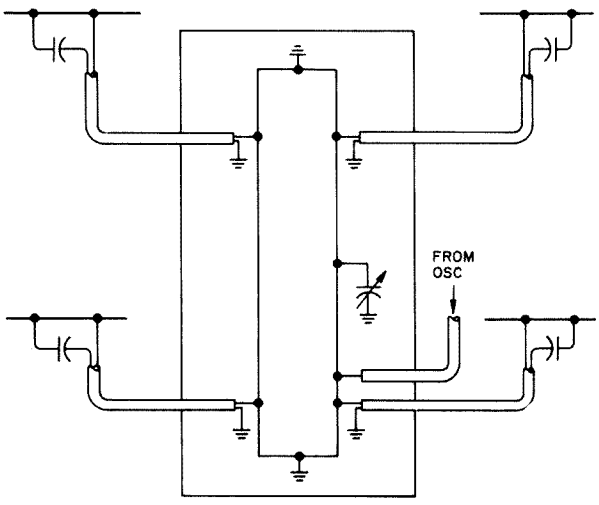


Fig. 7. Cabling diagram, 8 element.

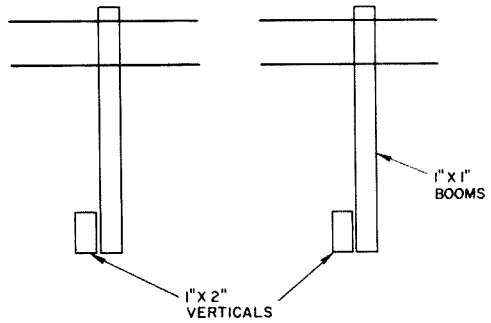


Fig. 8. Mounting detail, top view.

checks run so far, these are not needed. Theory says that when the center-conductor leaves the confines of the coaxial cable, as at the connection to the strap, inductive reactance begins to build up and requires the use of a series capacitor to cancel the inductance. Evidently the distance of ¼ inch is too small to notice at 432 mhz. As you can see in **Figs. 1** and **7** the four 50 ohm individual yagi cables are soldered directly to the strap.

Basic 8 Element Beam

Fig. 6 shows the basic 8 element beam with the final spacings of the elements and yagis. D, the spacing between radiators and reflectors, is a little controversial at present. D1 equals 2¼ inches, D2 equals 2½, and D3 and D4 equal 3 inches. This is probably due to the Gamma match capacitors, in which case one percenters may be called for. Will see what the answer is with the "Big Beam." Maybe a final tune-up point of this kind will give you that last db you're looking for.

Fig. 7 is the schematic of the 8 element, and **Fig. 8** shows boom mounting detail.

The gain of this basic 8 element beam looks very good. In the second part of this "20 DB Beam" article careful gain measurements using the distance method will be given.

The dipole; 2 element; 8 element; a 14 element yagi tuned up for maximum gain; and the 16 and 32 element beams being designed at present will be measured. Several other combinations may be tried as well, such as four 5 element yagis, four 10 element yagis, etc. *Another* 32 element may be added to the first for that last needed additional 3 db. This article may run into *three* parts, so just keep reading!

. . K1CLL

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IDENTIFYING AND CONVERTING G.E. PROGRESS LINE EQUIPMENT

In the surplus commercial FM equipment market, the General Electric Progress Line equipment has often been overlooked in favor of the somewhat more popular, and possibly more available Motorola gear. The lack of good conversion information basic enough for the FM newcomer, such as has been available on the Motorola gear, has undoubtedly contributed to the lack of interest in GE equipment. I hope to provide some basic information to the ham who has or may acquire a 150 MHz Progress Line unit and would like to use it on 2 meters.

The Progress line has gone through the usual adaptations and improvements right up to the present fully transistorized models. With the exception of the transistorized versions, and some later MTS combinations, they all contain similar and interchangeable transmitter and receiver strips with all the standard features incorporated that the average ham would require. Because it is more likely that you will come upon one of the earlier Progress Line units we will direct our discussion toward them.

Equipment Identification

As a means of describing the complete unit GE employs a combination nomenclature which tells us three things; the type of housing or application, the type of power supply and its voltage, and finally, the series designation. Table 1 will explain what each designation means. While the information given may not be an exact interpretation as might come from the factory, it is adequate

Table 1
Station Combination Identification

FIRST LETTER - Cabinet Designation
- M Trunk mount
- F Front mount
- T Table top
- W Trunk mount mobile telephone application
- WT Table top mobile telephone application

SECOND LETTER - Power Supply Designation
- A 6 volt vibrator
- E 12 volt vibrator
- A/E Dual vibrator type
- T 12 volt transistor
- U 24 volt
- O 117 VAC continuous duty
- I 117 VAC intermittent duty

NUMBERS - Station Combination Series
- 33 20–25W
- 36 40–50W
- 37 100W
- 38 250W

Note: Other designations may be found from time to time, but those included here are the most prevalent. This is not intended to be an all-inclusive list.

Example:

M A/E - 36 X X
- M — Cabinet designation
- A/E — Power Supply
- 36 — Series combination
- X — Receiver bandwidth (W or N)
- X — Control designation

for our purposes and covers most station combinations in the 144 to 174 MHz band. One or two letters may follow the combinations series number to indicate receiver bandwidth and the type of control. Where the station is locally controlled, no designation is used.

Unlike the Motorola designations, the GE combination nomenclatures do not tell exactly what kind of transmitter and receiver strips are employed in a particular unit. In most cases the strips are interchangeable, as mentioned above, and you may actually find most anything inside the case. The only way to be sure is to look. Type numbers are found on the top of the chassis along the rear edge and will look something like: *4ET20A1 Rev. B.* A quick look at Table 2 will tell you just what each strip is. In the example you will note that the type number is followed by an additional set of letters indicating the particular revision of the basic strip. GE, like all the other manufacturers, have a penchant for changing a resistor value somewhere along the line or possibly adding a capacitor to improve the performance. Don't worry too much about this because the strips are essentially the same regardless of the revisions.

It is possible that you may come across a unit that was used originally as a mobile telephone. These should not be confused with the later mobile telephone versions which were called *"MTS Mobiles."* The earlier Progress Line units which were used for mobile telephone service are generally distinctive by their somewhat longer cases, usually 20 in., required by the special accessory deck needed to make it operate as a telephone. These units will have a designation like *WTA-33-W* or *WI-33* and are basically MA/E-33 units which were manufactured to Western Electric specifications. All the standard functions of a straight two-way radio are incorporated in these units and appear at the 21 pin control cable jack.

Inside the unit the strips are connected by a wiring harness that originates in the power supply chassis and terminates in several color-coded plug-ended branches and the 21 pin control cable jack. In early mobile telephone combinations the VS1 Selector panel can be removed without affecting the normal functions. If the multifrequency deck is missing, single channel, and possibly two channel, operation can be accomplished by plugging the crystals into the appropriate sockets on the transmitter and receiver strips. Just let the two plugs, the black and the blue ones, which connected the Selector panel and the multifrequency deck hang loose, as they will not hinder the operation. Someday you may acquire a multifrequency deck and all you will have to do is plug it in and do a bit of minor retuning.

All tube type 150 MHz Progress Line combinations employ 4ER25 model receiver strips with the suffix A through F. If yours is an E or F, look for a lot more work, as

Table 2

Transmitters

Frequency Range	144–152 MHz		152–174 MHz	
Nominal Power	1 Freq.	2 Freq.	1 Freq.	2 Freq.
20–25W	4ET20A1	4ET20A11	4ET20A2	4ET20A12
40–50W	4ET21A1	4ET21A11	4ET21A2	4ET21A12

All transmitters are continuously adjustable for 0–15 kHz deviation for narrow or wide band operation.

Receivers

Frequency Range	144–152 MHz		152–174 MHz	
	1 Freq.	2 Freq.	1 Freq.	2 Freq.
Narrow Band	4ER25A1	4ER25A11	4ER25A2	4ER25A12
Wide Band	4ER25B1	4ER25B11	4ER25B2	4ER25B12
Narrow Band[1]	4ER25C1	4ER25C11	4ER25C2	4ER25C12
Wide Band[1,2]	4ER25D1	4ER25D11	4ER25D2	4ER25D12

[1] These receivers are later versions and employ fewer tuned stages to attain the same rated performance.

[2] Models 4ER25D03 and 13 are 130–150.8 versions.

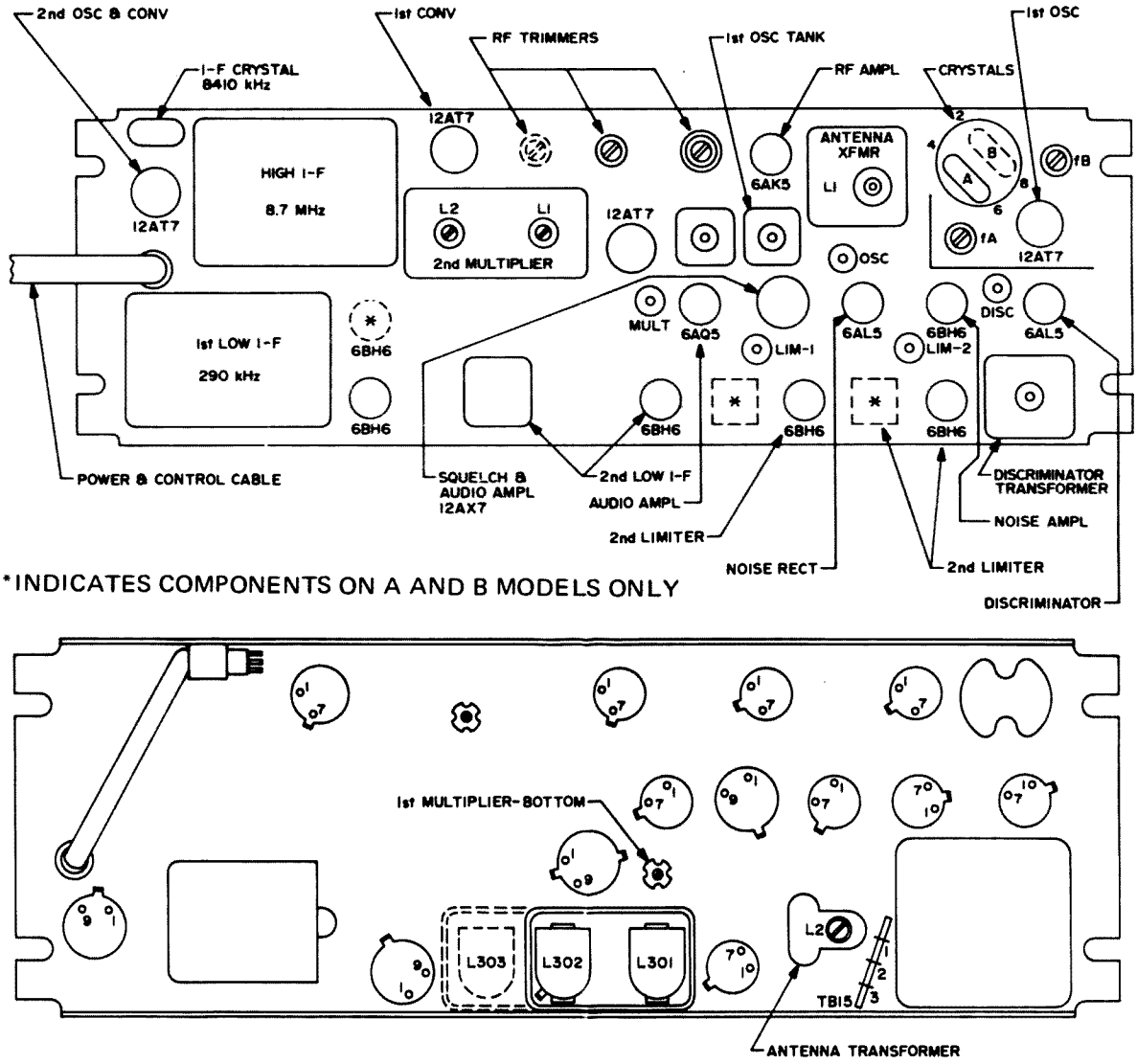


Fig. 1. Location of components on receiver chassis.

these are used in later duplex combinations and will require external modification to provide squelch and volume controls. You can also expect to rework or replace the power supply as it will be delivering power to both the transmitter and receiver at the same time. You will also find that your Progress Line unit will have either a 4ET20 or 4ET21 transmitter strip in it, even in the duplex combinations, although the duplex versions utilize a duplexer which will have to be replaced by an antenna relay or a TR switch. A recent article (*QST*, June 1971) may help in converting from duplex to simplex operation in the later MTS Progress Line units.

Now let's get down to the business of the actual conversion. More than likely you will find that your unit will be for the 152 to 154 MHz portion of the band. A few simple steps will bring the unit into the FM portion of the 2 meter band.

Crystals

For best results and ease of ordering, commercial standard crystals are the easiest. All you have to do is specify the type number of the strip you are ordering the crystals for, the crystal frequency, the channel frequency and whether you intend to use it in an oven. Check your favorite crystal catalog for the specific information they require.

The transmitters have a multiplication factor of 24, so just divide the desired operating frequency by 24 to determine the crystal frequency. The first oscillator crystal frequency for the receiver can be determined by subtracting 8.700 MHz from the channel frequency and dividing the results by 12. If

you are lucky the receiver will have the i-f crystal in it; if not, order one for 8.410 MHz. While you are waiting for your crystals to come in the mail, you can start on the next steps.

Receiver Conversion

To obtain at least rated sensitivity[1] it is necessary to pad several places in the receiver. The trimmers used in these receivers can be turned a full 360° and will give the impression of being fully peaked when actually you are only passing through the maximum capacitance point of the trimmer. You can approach the padding in one of two ways: install a new capacitor of the correct value at each point to be padded or get a handful of 4 pF capacitors and parallel the existing capacitors with them. The purists among us will undoubtedly use the first way, the rest of us the second way. Either way use good quality 500 wvdc tubular ceramics with −80° temperature coefficient.

In the A and B models there are seven places to be padded and six places in the C and D models. Start by removing the strip from the unit to facilitate handling as you will be turning the chassis over several times. Refer to Fig. 1 to locate the coils that are to be padded. Be sure to check Table 2 to determine if padding is necessary in the receiver you have.

A quick inspection of the antenna transformer and the rf trimmer cans will tell you what is required to remove them so the coils can be reached. L1 will come off with the can and can be removed by taking out the three screws on the side of the can near the antenna input jack. Note the position of the screws in the slots so that L1 can be replaced in essentiallly the same place, although you may want to slide it up or down for best results as indicated by the LIM-1 meter reading when you tune up.

The can which contains the second multiplier coils is far more difficult to remove and care must be exercised to prevent damage to the components inside. When the receiver was manufactured the components were installed in the loose can and then wired. The can was positioned on the chassis and the leads fed through to the bottom side and soldered in place. Reversing this procedure, while difficult, is probably better than trying to remove the can without unsoldering, although I have done it in this way. Remember to tag the leads. The following list indicates the required padding capacitor values.

	Coil	Existing Capacitor Value	Change To
Antenna	L1	10 pF (C2)	14 pF
Transformer	L2	6 pF (C4)	10 pF
Rf Trimmers	L301	3 pF (C309)	7 pF
(see note	L302	9 pF (C306)	13 pF
below)	L303	None	4 pF
Multi-2	L1	7 pF (C2)	11 pF
Transformer	L2	10 pF (C3)	14 pF

Note: In the C and D models L303 has been eliminated. However, use the values given for L303 for L302 in these receivers.

If the receiver strip is equipped with a trimmer below the opening marked fB, the receiver is capable of two frequency operation. However, upon inspection you may find that pin 3 of the first oscillator tube socket had been permanently soldered to ground, which makes channel A operative continuously. Assuming you want two frequency operation, unsolder pin 3 from ground and add a short length of hookup wire between pin 3 and lug 1 of TB15 (lug 1 is the one with the green braid covered wire leading directly to it from the cable). TB15 is directly below the antenna transformer (see Fig. 1). If it is not already in place, add a wire similarly between pin 8 and lug 2 of TB15. Leave both of the 0.02 uF disk capacitors in place on TB15. Also solder a short piece of hookup wire between pins 1 and 6 to complete the plate circuit of the section of the oscillator. You should now be able to select channel A or B from the channel selector switch on the control head.

If the control head is not equipped with a channel selector switch one can be added easily. Install an spdt toggle switch in a convenient location on the control head and ground the common terminal. If the control cable leads are marked, connect wire #12 to one side of the switch for channel A and wire #13 to the opposite side for channel B. If you are adapting a control cable that is not numbered, simply ring out for conti-

[1] Rated sensitivity: 0.5 μV (20 dB quieting method).

nuity between pins 4 (channel A) and 5 (channel B) of the 21 pin control cable plug and connect the loose ends to the control switch as described above.

All 4ER25 type receivers can be converted to two frequency operation by adding a 39K, ½W, 10% resistor and a 3 to 12 pF ceramic trimmer as shown in Fig. 3 and making the changes described above for frequency selection.

Tuning the Receiver

With the appropriate crystals in their sockets, apply power to the receiver and let it warm up. Using a 20K ohms/volt vom with a 2½–3V dc scale, ground the positive lead to the unit in the GND test jack on the power supply chassis. Insert the other lead into the OSC test jack. Tune the first oscillator tank to maximum and then back off on the gentle slope side until you have a reading of about 1.35V. If you are using commercial standard crystals cut specifically for the unit, you will generally get the greatest output from them at or very near the correct frequency. Adjust the oscillator trimmer (fA or fB) for maximum meter reading and then readjust the tank coil until you again have about a 1.35V meter reading. In multifrequency applications the oscillator must be tuned on the highest channel frequency.

Next, move the test lead to the MULT jack and tune the first multiplier coil, both top and bottom alternately, for maximum meter reading.

With the meter probe in the DISC jack, connect a signal generator to the antenna input jack and zero the generator to the discriminator. Move the meter probe to the LIM-1 jack and reduce the generator output to the lowest value that gives an indication on the meter. It is possible that you may not get a reading at this time. If this is the case, move the meter probe to the LIM-2 jack and with maximum signal generator output, adjust the antenna transformer top and bottom, the two trimmers of the MULT1-2 transformer and the two or three rf trimmers for maximum indication. Return the meter lead to the LIM-1 jack and repeat each of these steps. As the meter readings increase due to tuning, reduce the generator output to the minimum needed to give an indication. Too much signal will saturate the limiters and give a poor indication. Occasionally move the meter probe back to the DISC jack and zero the generator as necessary.

Finally, with an antenna connected to the receiver, listen for an on-the-air signal and adjust the OSC-1 trimmer so that you get a zero discriminator reading. Remember that the guy you hear may not be exactly on frequency, but if someone else can hear him

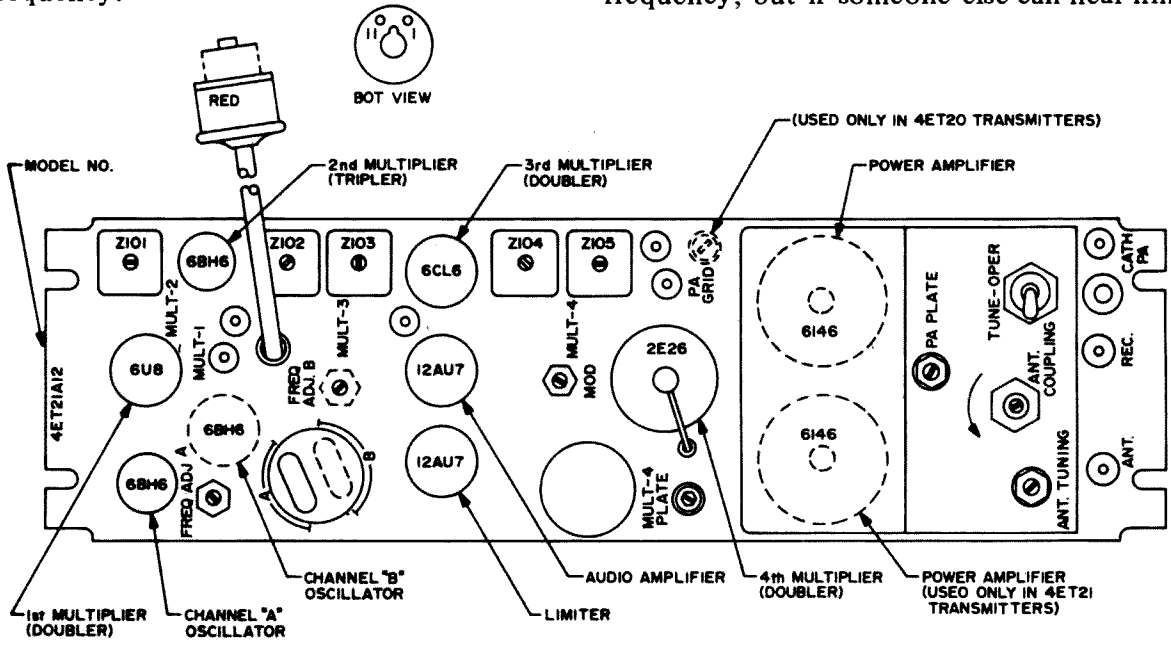


Fig. 2A. Location of components on transmitter chassis.

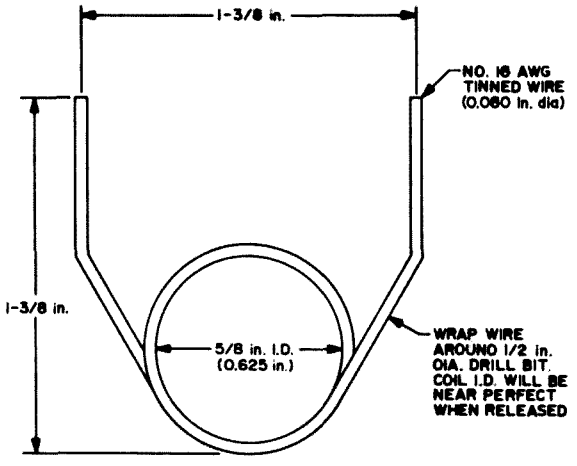


Fig. 2B. Power amplifier plate coil replacement.

it's a good bet that he is at least close. You can always touch it up a bit later on when you find someone known to be on frequency or when you acquire that secondary standard.

It is worthwhile to go back over all of the above adjustments while listening to a steady, clean signal that gives about 0.5 to 1.0V LIM-1 reading.

That's about all there is to getting your receiver to work reasonably well. Adjustment of the i-f, limiter and discriminator stages will usually not be necessary and should be avoided. If you must adjust these stages get a copy of the appropriate bench alignment procedure published by GE, if possible, before you attempt it. The coils in these stages are overcoupled and must be loaded with the proper load resistor to make them critically coupled and then tuned in the proper sequence for good results.

Transmitter Conversion

Only one relatively simple change is required to make the 152 to 174 MHz units work in the 2 meter band. The power amplifier plate coil (L113) must be replaced with a new coil made up as shown in Fig. 2B. The coil should be fabricated of tinned 16-gage wire (0.08 in. diameter) wound 1 1/3 turns at five turns per inch, to an internal coil diameter of 0.625 in. (5/8 in.).

Remove the perforated cover from the power amplifier housing, pull out the 2E26 drive tube and the PA tube so you can reach the coil to work on it. Carefully unsolder the rf choke attached to the bottom of the coil loop. To make coil removal and replacement easier, remove the nut holding the PA plate tuning capacitor and the two screws on either side of it and slip the coil, capacitor and the steatite posts out of the housing. Unsolder the large recetangular plate coil and remove it from the clips. It may be possible to make your new coil out of the old one,although I have never tried it. Insert the ends of the coil into the clips to the approximate position and solder one side. Reinstall the entire assembly into the housing. Adjust the coil up or down until it is even with the load coil by heating first one side, then the other, and making slight adjustments in the coil height until the correct position is reached.

With the loading coil turned fully counterclockwise, adjust the new plate coil so there is 1/16 in. between it and the loading coil. Solder the free end of the rf choke to the center bottom of the front loop of the new coil, i.e. as you look into the open end of the PA housing. Be sure that in soldering in the rf choke you have not shorted the plate coil. Recheck the coil turn spacing and the distance between the two coils, and if all is well replace the tubes, plate caps and the housing cover and proceed to tuning up the transmitter.

Tuning the Transmitter

Transmitter tuning is basically a matter of peaking and dipping the various stages and should present no formidable problems. With the proper crystal in its socket, apply power and let the transmitter warm up. Flip the TUNE-OPERATE switch to the tune position and turn the ANT COUPLING countrol fully clockwise (uncoupled). The transmitter must be in its case or resting on a metal plate while it is being tuned or it will be detuned when it is returned to the case. Connect the unit to a dummy load for the initial tuneup procedures.

Plug the positive meter lead into the GND jack on the power supply and the negative lead into the MULT-1 jack. The oscillator and modulator stages are working properly if the reading is 1.5V or more. Move the meter lead to the MULT-2 jack and tune Z101 for maximum meter reading. *Do not key the transmitter for longer than 30 seconds at a*

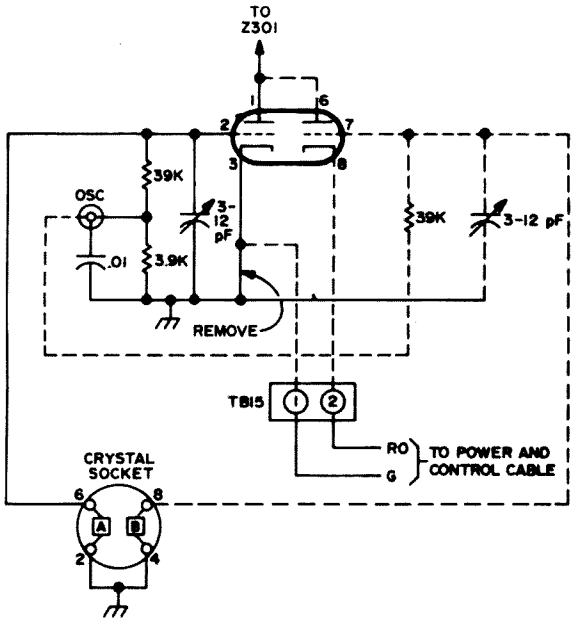


Fig. 3. First oscillator circuit of receiver. Add dotted wiring for two frequency operation.

time until after the MULT-4 plate has been tuned.

With the meter lead in the MULT-3 jack, alternately peak Z102 and Z103 for maximum meter reading. The best way to tune this stage is to turn the adjusting screws in about ¼ turn each alternately, until the maximum reading is reached. If a peak cannot be obtained, connect the meter to the screen (pin 6), using the 300V scale, of the 6BH6 second multiplier and tune Z102 for a slight dip in screen voltage. It is possible to tune Z102 and Z103 to the wrong harmonic of the crystal frequency. If this is suspected, turn both of the adjusting screws all the way out (counterclockwise) and retune to the first peak in the manner noted above.

Next, plug the meter into the MULT-4 jack and alternately tune Z104 and Z105 for maximum meter reading. If this stage is badly misaligned, pretuning can be accomplished by tuning Z104 for a slight dip with the meter lead plugged into the MULT-3 test jack.

Now move the meter lead to the PA GRID test jack and alternately tune MULT-4 PLATE and PA GRID controls for a peak (MULT-4 PLATE only in ET-21 type transmitters). A small voltage reading will be present at the start because of the fixed bias at this point.

For each of the following steps the negative meter lead must be plugged into the GND jack and the positive lead into the CATH PA jack.

Tune the PA PLATE for a dip. Dip MULT-4 PLATE and PA GRID (if it is present). Flip the TUNE-OPERATE switch to the operate position and quickly redip these controls. Alternately tune the PA PLATE and ANT TUNING controls until a lower reading cannot be obtained. When the minimum reading is reached, retune ANT TUNING for a peak. If there is no indication of a peak increase the coupling by turning the ANT COUPLING control slightly counterclockwise until a peak can be seen. Increase the ANT COUPLING until the meter reads 1.4V and again adjust the ANT TUNING for maximum indication. The ANT COUPLING should now be increased until a reading of 1.6V for ET-20 models and 1.5V for ET-21 models is obtained.

Move the negative meter lead back to the PA GRID jack and the positive lead to the GND jack and retune MULT-4 PLATE and PA GRID for maximum indication. Once this is done, and with an antenna connected, return the meter leads to the CATH PA and GND jacks as in the steps just above, and adjust the ANT TUNING control for maximum meter reading. The ANT COUPLING should be readjusted to 1.5 or 1.6V.

The transmitter should now be putting out at least its rated power of about 25W. Greater output can be obtained by increasing the ANT COUPLING or replacing the 6146 final with a 6146B in the ET-20 models. There is the danger of overloading the power supply, however, unless the unit is equipped with a high power supply (two transformers) which may be present, particularly if the unit had once been used as a mobile telephone. In this case it may be possible to obtain up to 40 or 45W from a single 6146B final. The modifications described above should result in performance at least equal to the manufacturer's ratings assuming all of the tubes are good. A gain antenna will help immensely and with a good preamp ahead of the receiver, sensitivities as low as 0.1 to 0.2 mV are possible.

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PHASING MULTIBAND VERTICAL ANTENNAS

Most amateurs don't have the space for rotatable directional antennas for the 40 meter band—not to mention 80 meters—yet these are our most crowded bands under average conditions. Some sort of directional antenna is of tremendous value for stateside contacts and almost a must for DX. Many hams with limited space are using trapped multiband verticals. With a decent ground system, these are wonderful antennas, but they aggravate the QRM problem even more with their omnidirectional characteristics.

The use of two or more multiband trapped verticals and the proper phasing and switching setup provides an inoffensive (to the neighbors, I mean) and very effective method of obtaining directivity. This is essential for overcoming at least some of the QRM on receiving, and for giving that extra kick to your signal that can mean the difference between a solid QSO and none at all.

If you are presently using one trapped vertical, you already have almost half the system. I am sure every dedicated 40 meter operator will take pleasure in hearing Radio Moscow drop 20 to 30 db at the flip of a switch.

Some Theory

Since many handbooks barely mention phased verticals, a little theory is in order. For an example, let's use two identical verticals spaced one-half wave length apart (**Fig. 1**) and driven equally and in phase. The fields of the antennas are uniform in all directions in the horizontal plane and look like point sources of circular waves as viewed from above. Any point along the line W-E is a half wave length further from one vertical than the other. In other words, at any point along the W-E line, the two radiated waves are 180° out of phase and cancel. At any point along the N-S line (broadside) the

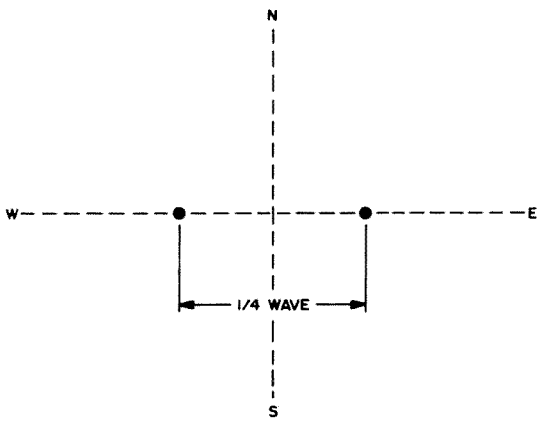


Fig. 1. Top view of 2 vertical antennas with ½ wave spacing.

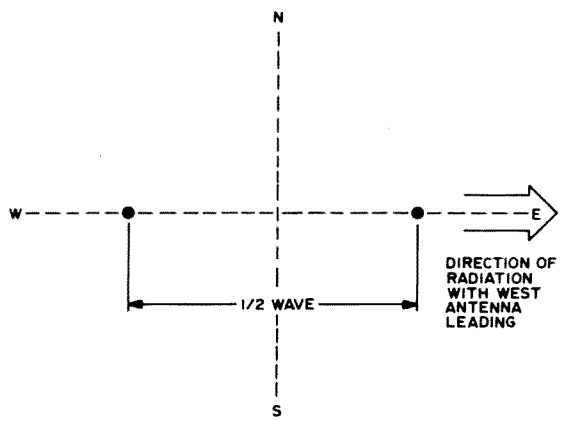


Fig. 2. Top view with ½ wave spacing.

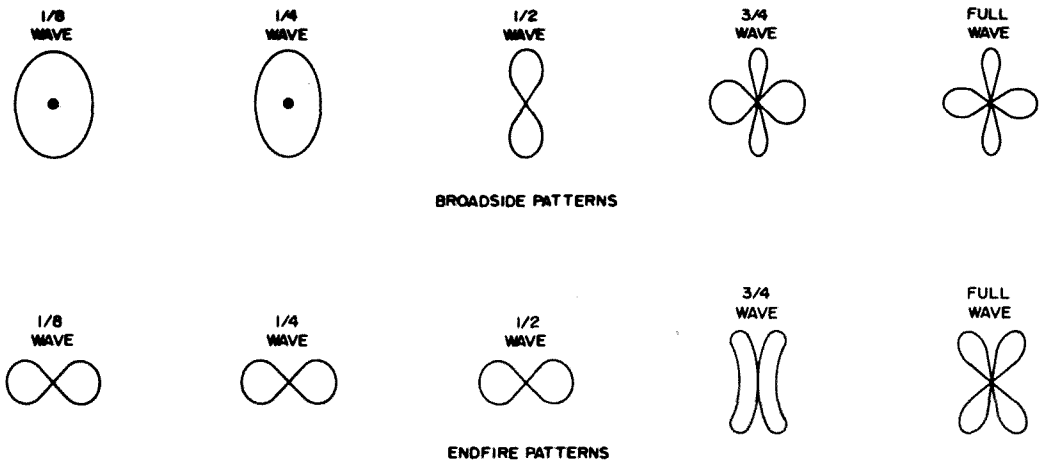


Fig. 3. Phased vertical radiation patterns for various spacings.

waves are in phase and reinforce. This then is a broadside array.

If the antennas in Fig. 1 were driven 180° out of phase, by feeding one antenna directly and inserting a 180° coax delay line in the other feeder, there would be reinforcement along the W-E line (endfire) and cancellation on the W-S line. So by using the same antennas and switching the appropriate length of coaxial cable in and out of the feedline, we have a choice of two directions, N-S or E-W.

If the verticals are spaced a quarter wave length apart (Fig. 2) and driven 90° out of phase with the west leading, the pattern will be a cardiod (heart-shaped) toward the east. Broadside gain for half-wave spacing is 3.86 db and 2.3 db for endfire with side attentuation around 20 db. A front to back radiation of up to 30 db can be achieved with quarter wave spacing for the cardiod pattern. Radiation patterns for various spacings are shown in Fig. 3.

As with any multiband system, there are some disadvantages. Definite endfire–broadside patterns are obtainable with eighth-wave, quarter-wave, and half-wave spacing. For full-wave and three-quarter-wave spacing, the patterns are not so cut and dried. A full-wave broadside pattern somewhat resembles a 4-bladed propeller, and the full-wave endfire pattern fills in the gaps between the 4 lobes (or blades). Even so, this directivity can be used to advantage by careful plotting on a great circle map or by the use of an "S" meter.

Practical Design

The first step in setting up a phased vertical system is to decide on the spacing. This will be determined by either physical limitations (how big your yard or roof top is) or by your choice of bands. For example, if you enjoy 40 meter DXing, quarter-wave spacing for 40 meters will result in very usuable eighth-wave and half-wave patterns for the 80 and 20 meter bands respectively. The antenna will be most effective on 40 because the quarter-wave spacing also yields a cardiod pattern on this band. The three-quarter and full-wave spacing result in the four lobed patterns on 15 and 10 meter bands.

The second step is deciding in which direction to beam the patterns. For instance, mounting the verticals on the N-E–S-W plane will put a 40 meter cardiod pattern towards Europe and another towards Australia and New Zealand. The broadside pattern will fall on Alaska and South or Central America. Reference to a great circle chart centered on your QTH will resolve this problem.

Step three is tougher: the physical mounting of the two radiators. As with any vertical antenna, success or failure lies in the ground system. There are too many hams who curse the vertical antenna that they

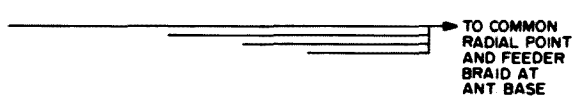
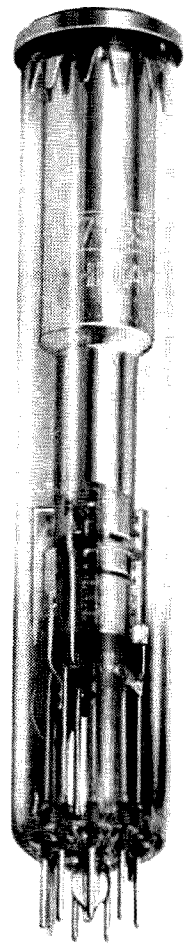


Fig. 4. TV rotator cable cut as a 4 band radial.

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"tried back in 19 and Blah Blah" and took down the following spring because it didn't work. Almost invariably, further questioning reveals an inadequate ground system or attempts to use the antenna for consistent short range work. Having successfully used verticals at five different locations in four states, I would recommend a roof or mast mount with at least three drooping radials for each band. Multiconductor TV rotator cable can be used to avoid having your yard look like a giant spider's lair. Measure and cut each conductor to a quarter-wave for each band desired, as shown in **Fig. 4**. Tie and solder the antenna end to a lug and you've got a multiband radial. Three such radials drooping from the base of the vertical make a very effective counterpoise. A roof mount in the average location has the added advantage of allowing you to mount the radiators well clear of nearby objects, thus helping maintain identical radiation patterns. Bear in mind that the success of the phasing depends on the words "identical patterns." If you are fortunate and live in a swamp, it would, of course, be best to use buried radials.

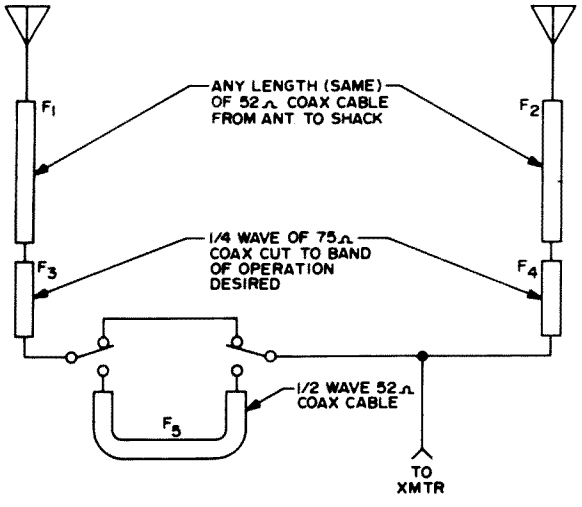


Fig. 5. Basic broadside-endfire switching.

All directional and band switching can be done from inside the shack. Identical coax feeders of the same length are brought from the base of each antenna into the shack. The lengths of these lines can be ignored for the phasing line calculations because they are the same length.

Phasing Lines

Fig. 5 illustrates the basic endfire–broadside arrangement using full to one-eighth-

wave spacing. Feeders F1 and F2 are any equal length needed to bring the feeders to the switching point. F5 is shorted for broadside, and switched in the circuit for endfire. Fig. 6 shows a cardiod pattern setup for two directions. F5 in this case is one quarter-wave long, and the antennas are spaced a quarter-wave length apart. If F5 is switched out of both feed lines, the antennas are in phase and a broadside pattern results.

The phasing line lengths can be calculated from the formula: one-quarter wave x velocity factor frequency. The velocity factor for regular coax is .66, and for polyfoam it is .75. It is necessary to switch phasing lines F3, F4, and F5 for each band. This seems rather complicated at first glance, but it can be done with two switches. The switches can be mounted in a large minibox with coaxial connectors on the rear for all the phasing lines and antenna feeders. The use of coaxial switches would be the best approach although rather expensive. Excellent results can be obtained with good quality ceramic switches such as ones currently available on the surplus market. If the switch box is built using coaxial connectors for all the phasing lines, it might be wise to purchase these surplus also in order to keep costs down.

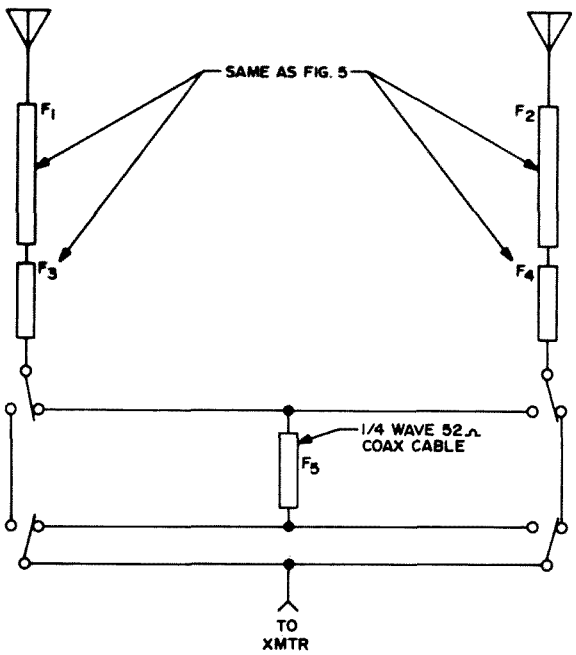
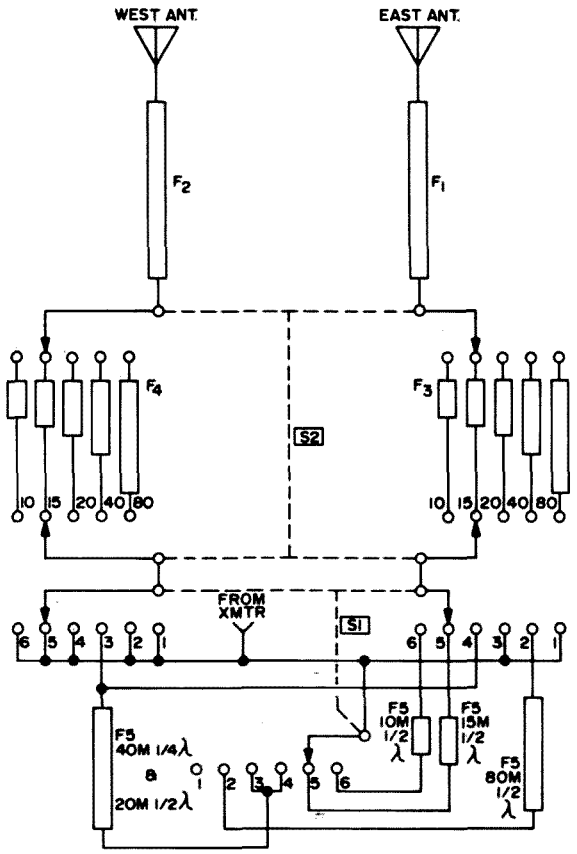


Fig. 6. Basic cardiod switching with quarter wave spacing.



F1 & F2 = EQUAL LENGTHS OF 52Ω COAX CABLE.
F3 & F4 = 1/4 WAVE TRANSFORMER OF 75Ω COAX CABLE.
F5 = PHASING LINES OF 52Ω COAX CABLE.

S1 SWITCH POSITIONS
1. ALL BAND BROADSIDE.
2. 80M END-FIRE.
3. 40M WEST CARDIOD AND 20M END-FIRE.
4. 40M EAST CARDIOD AND 20M END-FIRE.
5. 15M END-FIRE.
6. 10M END-FIRE.

Fig. 7. Switching arrangement for 5 band trapped verticals.

Switch Box Construction

A practical example of a band switching system evolves from Fig. 5 and 6. This is shown in Fig. 7. Two switches are used: a 5 position, 4 pole and a 6 position, 5 pole. If the trapped verticals in your installation cover 40 through 10 meters, one position can be eliminated or terminated in your dummy load for tune-up purposes. Keep leads short and no problems with high SWR will be experienced.

To avoid confusion, both ends of each phasing line can be marked with adhesive tape and a ball point pen. The phasing lines can then be neatly coiled and stacked in a box (or perhaps a wastebasket) under the operating table. A lot of effort is involved in a good antenna system, and this one is no exception. I think you'll find, as I did, that the returns versus effort ratio is pretty high.

. . . KØWF

Jerry Selenke W9JER
Vocation Central
Donaldson IN 46513

HAM TV: A Public Service

Ham radio has, since its inception, been permitted and sometimes tolerated by the federal government primarily because of its value to the nation in times of disaster. As a consequence of this, ham radio clubs have frequently allied themselves to the various Civil Defense programs around the country. Like many of these clubs, the Marshall County Amateur Radio Club of Plymouth, Indiana, has followed this route. Unfortunately (?), no calamity appeared to afford our club the opportunity to make use of our meticulous preparations. Our energies were channeled toward preparing for events whose possibility of coming about were remote.

Consequently, the club began looking for a service-type project to which the club could devote itself. Although some members put the project described here on a par with the above mentioned calamity in terms of actually reaching fruition, the club decided to give the project a try.

The motto that "amateur radio exists because of the service it renders," took on real meaning for our club. On September 6 (Labor Day), some 15,000 people viewed the annual Blueberry Parade in Plymouth, Indiana. Among these were 100 shut-in nursing home patients. The latter were provided with the televised coverage of the parade through the courtesy of the Marshall County Amateur Radio Club.

Shortly after an article on ham TV activity in this area appeared in the local newspaper I was approached by the publicity chairman for the parade. After considerable discussion with other active ham TV'ers, Wayne Zehner WA9INM and Bob Newcombe K9ZLM, who confirmed that the project was within the realm of technical capability even with our homebrew and sometimes downright crude equipment, it was decided to approach the club with the idea. After the question of legality was solved, the club decided to give it a try and preparations began in earnest.

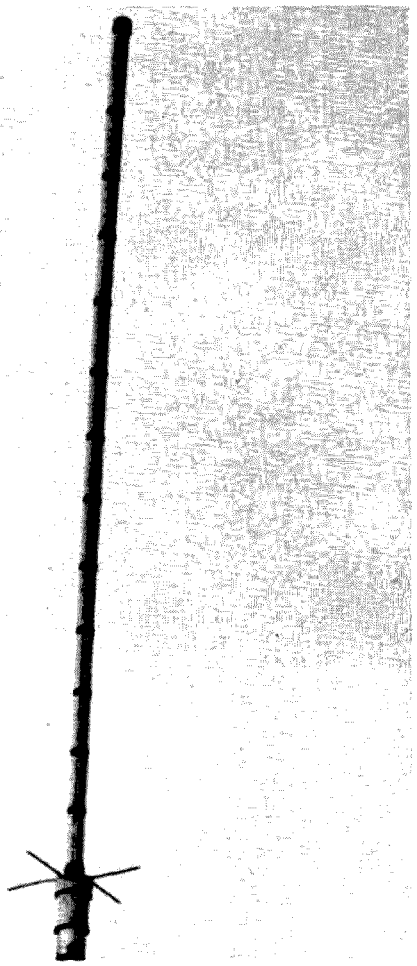
Since the purchase of 432 MHz antennas was beyond our financial resources, an antenna construction fest was organized. These antennas were bow-tie types with a solid metal reflector constructed out of blocks of

wood and aluminum salvaged from discarded highway signs. To facilitate construction it was decided to not use gain antennas at the receiving end of the network with the exception of one nursing home which was located approximately 5 miles from the transmitting site. At this location a 16-element collinear coupled with a preamp was installed. The lack of gain at the receiving ends was offset by a 10-element vertically polarized collinear transmitting antenna (July 71 *73*) constructed by WA9INM and K9ZLM. Vertical polarization was mandatory since the nursing homes were scattered at all points of the compass.

WA9INM began converting a surplus ART-28 for an outboard on a Motorola T-44 strip. After exhausting the expletives in the English langauge, WA9INM found that the Motorola strip wouldn't develop enough drive for the theoretically half-gallon ART-28. Due to a lack of test equipment operating in the 430 MHz range, this fact was discovered too late to allow time to start over. It was decided to use an RCA CMU-15 bare-foot. The fact that it developed an adequate 20W in a test run two weeks prior to the actual parade proved this unit to be more than sufficient to insure completely snow-free pictures at all 5 receiving locations.



W9JER asking for a video check from WA9INM at the business end of the in line and off the air monitors. WA9TZP, club president, is at left next to the club TV idiot card.



Ten-element collinear transmitting antennas constructed according to description in the July issue of 73.

After the antennas were constructed, the only problem – equipment wise – was obtaining converters for each of the receiving locations. Somehow the club managed to scrape up a sufficient number of ultraverters of the type Americans used to use before the FCC required manufacturers make UHF tuners standard on all TV sets. These ultraverters were slugged to tune 432 MHz and used channel 3 for the i-f.

On the test day everything was set up as closely as possible in the same manner as it would be on festival day. The 10-element collinear transmitting antenna and transmitter was set up on top of the 60 ft Plymouth Building on Michigan Street next to the reviewing stand. The transmitting antenna was on top of a 30 ft portable mast which gave us a total of 90 ft. To achieve



WA9INM watches for parade as W9JER pans local scenery.

his height, it was necessary to run 400 ft of RG-59U video line from the TV camera at street level to the transmitter. In order to overcome the line loss the target on the camera had to be turned up to an undesirable level. Regardless of the negative effect this would have on the camera when operating continuously for at least 2 hours, the video information portion of the signal rose to almost or equal level as the sync pulses which made for considerable tearing of the picture. Dick Basham K9ILU solved this problem by procuring a video amp from our local telephone company and his employer. He also obtained five combination headset-microphone sets from them which were used for closed communications with the camera, transmitter site and camera spotters.

Realizing that the FCC might frown upon duplication of services provided by commercial concerns, it was necessary to use the audio portion of the telecast from WTCA, the local radio station. The local engineer cooperated fully by setting up the announcers' table directly across the street from our camera site. Each nursing home was then provided with an FM radio, and in effect had a description of each parade entry as it passed, because the cameraman was plugged into a portable radio and thus was able to keep the camera on the entry being described by the radio announcer.

The day of the parade itself finally arrived with – you guessed it – rain. However, since hams in general have always been amply blessed with optimism, the club assembled and began setting up the transmitter, camera and all other related paraphernalia. Just when we began to lose some of that optimism, Mother Nature cooperated and the moisture ceased. Despite being a little damp, everything worked, and the club members took up their stations; Dick Basham K9ILU and Dale Schrom K9KRT, transmitters; Bill Washburn WA9TZP (the club president) as camera spotter and public relations; Wayne Zehner WA9INM and Bob Newcombe K9ZLM as troubleshooters; Everett Easterday WB9GSI, Red Easterday WB9AHF, Carl Bovee W9DHF, Mildred Bovee K9ZLB, Clarence Shaffer WA9VRK and Fred Doss WA9VRV at the various nursing homes; and I was on the camera.

For ID purposes a test pattern containing WA9INM's call letters under whose call the televising was conducted – and who incidentally was the prime mover behind the whole project – was positioned so that it could be shot at 10 minute intervals.

Amazingly, everything proceeded as planned, with only one exception. The first time Jerry W9JER, the cameraman, tried to zoom in a well-endowed majorette, he got the full force of 100V. Somehow there was ac on the camera chassis. This coupled with wet feet made for a "shocking experience." Not wanting to interrupt the coverage, WA9INM, the chief engineer, declined to reverse the ac plug. The televising continued, but the situation eased as everything began drying out.

About midway through the parade the odor of burning insulation permeated the camera platform. The thought of a $1200 camera going up in smoke sent everyone scurrying to ascertain the source of the odor. The problem was solved by an untechnical bystander who pointed out the smoking brakes of a horse-drawn wagon. It seems that the old timers constructed their wagon brakes out of material similar to that used in today's wire insulation. At least they smelled the same.

Aside from a brief light shower, the remainder of the parade went off without a hitch and even the transmitter did not blow as expected, since a CMU-15 is not rated for continuous duty. As soon as the last parade

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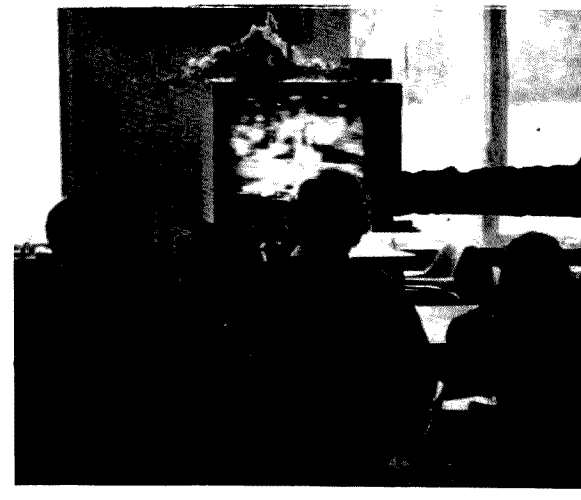
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two or more cameras, coverage to all nursing homes in the county, a TV repeater so that mobile units could be utilized, and (get this) televising in *color*. Fortunately, Mother Nature interrupted these discussions before they got out of hand by providing a drenching downpour exactly 15 minutes after the parade ended.

Besides giving the small Marshall County Amateur Radio Club a project on which to work together, the project – more importantly – provided some of our senior citizens with a little happiness and a break in the daily routine.

Each of the nursing homes made formal comments to the local newspaer, and a representative from the National Nursing Home manned by WB9GSI sent in the following: "It was just fabulous! We were so glad we were included and it gave our employees a chance to see the parade also. The men coming in beforehand to set everything up gave the patients a great deal of enjoyment. If the club ever tries to do this again, we hope they think of us."

. . .W9JER



A part of the audience viewing the parade at one of the nursing homes.

entry had disappeared down the street, everyone chipped in and began disassembling what to our mind was the greatest thing that ever happened to Marshall County. All reports from the nursing homes were superlative, not only from the hams stationed there, but also from the patients and staffs.

Even before the equipment was fully disassembled, talk turned to how we could improve the system next year . . . such as

John J. Schultz W2EEY
40 Rossie Street
Mystic CT 06355

THE MODIFIED SUCTION-CUP ANTENNA

A few simple modifications to the original suction-cup antenna provide greatly simplified tuning. The modifications also permit the antenna's tuning network to be used as an antenna coupler for random-length single-wire antennas, thus further extending the versatility of the unit as a simple, multiband, portable antenna.

The original suction-cup antenna consisted of a surplus folding whip antenna about 10 ft long with a loading coil at its base. It was intended for quick setup, particularly on an automobile, whenever a multiband antenna was desired for temporary operation. Apparently, the idea was appealing to many amateurs who wanted some portable operating capability while on vacation or some other trip but didn't want to install a regular mobile antenna installation. The whip and coil were wired together as shown in Fig. 1 (A).

The main objection that was heard about the antenna was the difficulty involved in finding the two correct coil tap positions, particularly when large frequency excursions were made. Although a procedure was outlined for finding the positions, many amateurs apparently found the procedure too time-consuming when they simply wanted to set up for portable operation for a short period of time. Various means were explored to simplify the tuning of the antenna. Details are given on one method that lends itself to simple modification of the original antenna and other methods are mentioned for the benefit of those who might like to construct a suction-cup antenna for the first time and, therefore, have more freedom in the placements of the tuning components. With the modification, tuning becomes a matter of simply tuning a variable capacitor instead of adjusting two coil tap positions. Generally a single coil tap position need only be changed when changing bands.

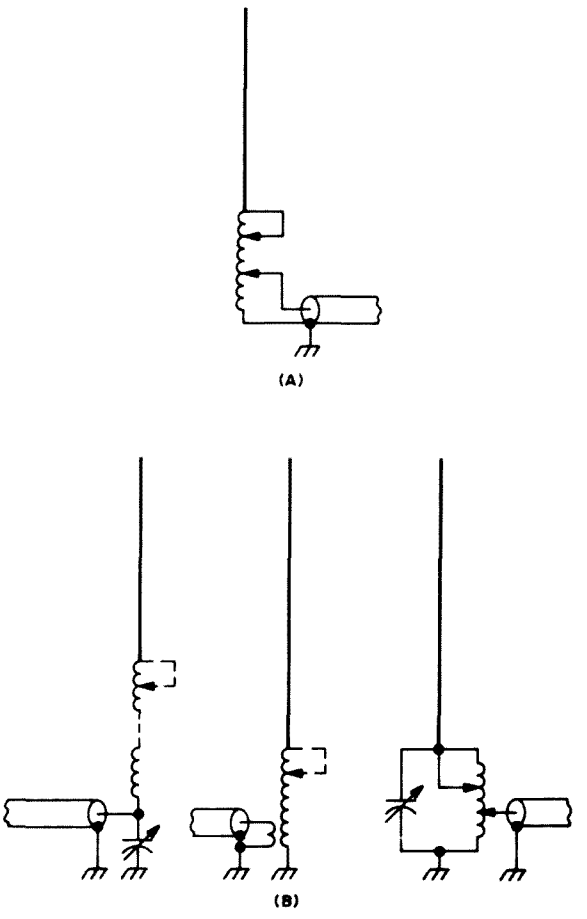


Fig. 1. The basic antenna loading scheme (A) and three networks which were considered in order to provide simplified single-band tuning (B).

Tuning Methods

There are several ways by which the coil taps shown in Fig. 1 (A) can be replaced for single band operation by a continuous tuning scheme. Some of these possibilities are illustrated in Fig. 1 (B). The simplest scheme is probably that there a variable capacitor is placed from the coax center conductor to ground and an extra inductor added to the basic whip loading coil. The extra inductor and the capacitor form an "L" network which can be tuned as desired to match the loaded whip. Although the scheme is generally simple for new construction, since only one inductor need be used which combines the loading and "L" network inductances, it does have a disadvantage in that the variable capacitor has to be fairly large. In fact, several thousand mmf may be required on 80 meters for a 10 ft whip. Fixed capacitors can, of course, be paralleled with a wide range variable capacitor. Another possible scheme is to leave the coil taps as in Fig. 1 (A) but use a 100–200 mmf variable capacitor across the entire coil. Such a scheme will eliminate the need to change the upper coil tap for operation over most of one band but the capacitor is subject to a fairly high voltage gradient and has to be a wide-spaced type for any appreciable transmitter power. The best compromise scheme seems to be that shown in the middle of Fig. 1 (B). Link coupling is used to couple to the loading coil in order to eliminate the transmission line coil tap. The series capacitor modifies the effective coil reactance so that adjustment of the one coil tap left is only needed for bandswitching. A capacitor of 250–325 mmf and medium spacing is sufficient for medium power transmitters.

Modified Antenna Construction

Figure 2 shows how the original suction-cup antenna was modified. Note that the ground end of the loading inductor is actually at the top of the inductor. As in the original, the coil is supported by two metal brackets (homemade of thin brass or copper strap) attached to the lower whip section. An additional bracket is added to support the variable capacitor (a Hammarlund RMC type unit). The capacitor has two threaded mounting holes on the bottom (not insulated from the frame or rotor). A screw is used directly to attach the lower whip bracket to the capacitor.

Since the middle bracket carries the mounting screw for one of the automobile top carrier-type suction cups, a small flat metal bracket about 1 in. long is used to offset the capacitor mounting from the bracket. Instead of depending solely upon the bracket's electrical contact to the whip, a No. 10 piece of wire is also run from a ground lug on the lower mounting hole on the capacitor to the terminal connection at the bottom of the whip. The lower end of the loading coil is connected to one of the stator terminals of the capacitor. About an 8 in. piece of wire with an alligator clip is connected to the other stator terminal in order to effect bandswitching by shorting out portions of the loading coil.

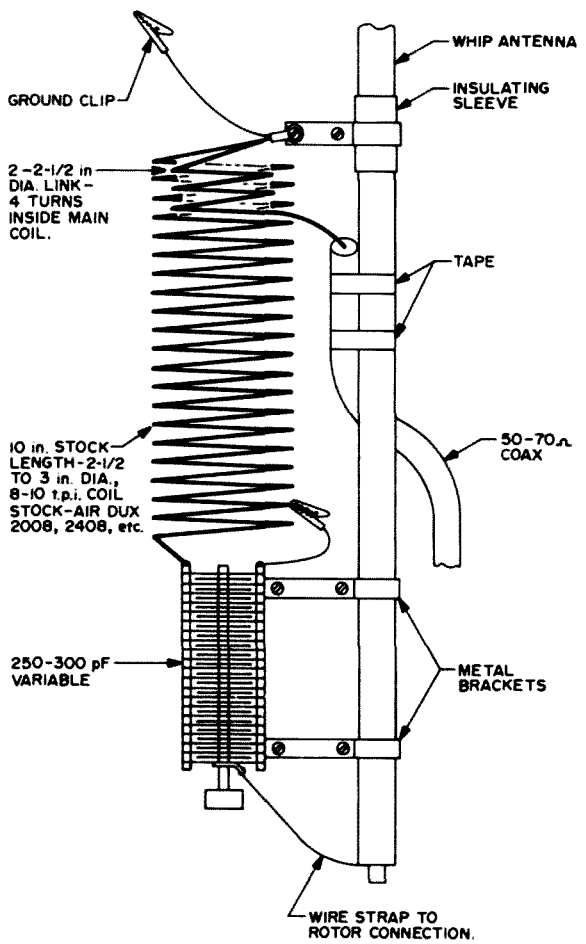


Fig. 2. Construction of the tuner components on the lower section of the whip. The suction cups, attached to the top two metal brackets, are not shown.

The coaxial transmission line coupling link is made of a piece of standard coil stock one diameter smaller than that of the loading coil. It fits easily within the top portion of the loading coil and is cemented in place by Duco cement used between the ribs of the two different diameter coil stocks. The coaxial transmission line is taped to the whip antenna rod, as shown in Fig. 2, with the inner conductor connected to the link coil and the shield to a lug on the upper whip bracket. Care must be taken that the shield of the transmission line is insulated from the whip antenna where it is taped to it for mechanical support.

The foregoing paragraphs were not intended to provide an extremely detailed description of the antenna's construction but mainly to highlight those areas which might require clarification. The use of components of widely different manufacture or construction will yield the same results but the same basic construction techniques should be observed.

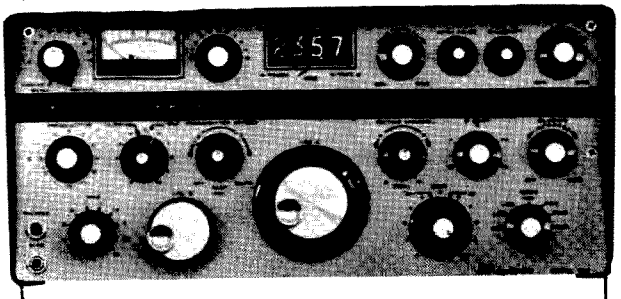
Adjustment

Proper adjustment of the antenna requires, at least initially, the use of an swr meter placed in the transmission line as near to the antenna as possible. The capacitor should be set at its mid-scale value. On any selected frequency band, the band coil tap on the loading inductor is then experimentally determined to produce the lowest swr. Varying the capacitor setting will then allow operation with the same coil tap position over a major portion of any low-frequency amateur band. Once the correct coil tap position has been found for a band, it is not necessary to monitor the transmission line swr. The variable capacitor can simply be adjusted for maximum field-strength indication response using the coil tap determined to be correct for mid-band operation. If desired, once the correct coil tap position for a band has been determined, a pin and jack arrangement can be used for band-switching. Standard banana-type plugs and jacks, for instance, are very suitable. The jacks are soldered on the coil at the correct mid-band position, as determined by swr measurements, and the alligator clip shown in Fig. 2 replaced by a banana plug.

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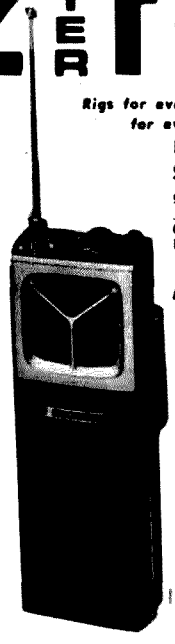
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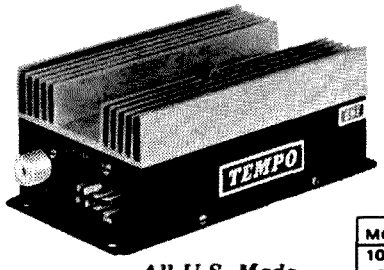
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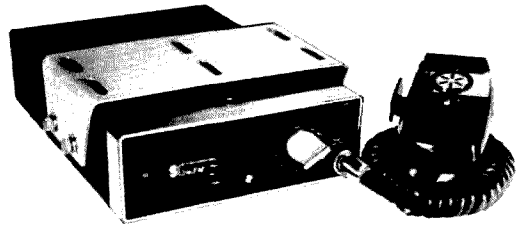
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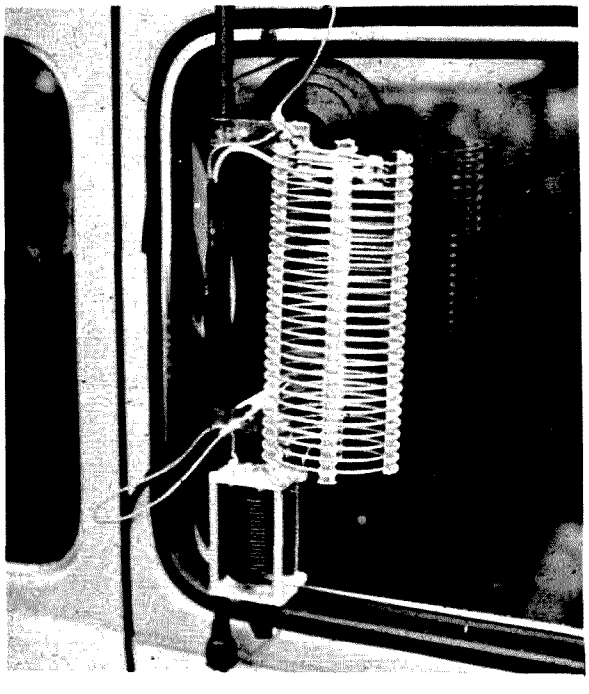


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Typical installation of the modified suction-cup antenna. Placement of the tuning capacitor at the bottom facilitates ease of tuning. Use of a Mueller 63C insulated clip instead of the uninsulated type shown is preferred.

Summary

The suction-cup antenna can easily solve the antenna problem for many temporary or portable operating situations. With variable tuning, the basic antenna becomes even more versatile and easy to adjust. A very handy feature of the modified antenna is its ability to serve also as an antenna coupler. For instance, if one is in a portable situation where it is possible to erect a long-wire antenna for greater efficiency, the tuning network of the suction-cup antenna can be quickly converted into an antenna coupler for the long-wire antenna. A shorting connection (by means of clip-on leads) is made from the rotor terminal of the variable capacitor to the upper (ground end) terminal of the loading coil, thus forming a parallel resonant circuit. The long-wire antenna terminal is then tapped on the main coil at a point producing minimum swr in the coaxial transmission line with the parallel resonant circuit peaked for maximum transmitter loading. Almost any random length of long-wire antenna can be easily tuned in this manner.

. . .W2EEY

Peter A. Stark K2OAW
196 Forest Drive
Mt. Kisco NY 10549

300 MHz FREQUENCY SCALER

This summer 73 Magazine is publishing a three-part article on building an IC frequency counter good up through the VHF range. That design has a built-in frequency scaler, and is good through almost 300 MHz. For those who have a low-frequency counter and just need a scaler to extend the range, here is a simple design which can be built for about $20.

The heart of the unit is a Fairchild μ6B95H9059X divide-by-10 scaler IC, which costs about $16 in unit quantities; we call it a 95H90 for short, and it's IC1 in Fig. 1, the schematic diagram. The output of this IC is fed into a 2N5771 PNP transistor which amplifies the output and provides a voltage change. If you have a counter which will go up to about 15 MHz, then this part alone will extend your range to 150 MHz. But if you have a slower counter, then you will need IC2 as well. This is an inexpensive ($1.30 or so) SN7490N TTL decade counter, which does a second division by 10. Both IC's together will take a 150 MHz signal and divide it down to 1.5 MHz.

The IC's need a voltage between +5 and about +5.3 volts. While you could build a power supply, that only increases the cost. The easiest way to provide power is with four D cells or a 6-volt lantern battery, which provides +6 volts. The 1N4001 diode, or another silicon power diode, drops this to about +5.3 volts. The scaler needs about 150 mA, so a set of four D cells will last about 10 or 20 hours with intermittent use.

Figure 2 shows a printed circuit board layout which can be used to mount the scaler, and Fig. 3 shows the parts placement on the board. Leave the copper border around the board, to act as the ground connection for the board. Use phono jacks or rf connectors, and bypass the +6 volt lead. The purpose is to let rf into the box only via the input lead.

In use, avoid over-driving the scaler. Start with a low input level, and feed in just

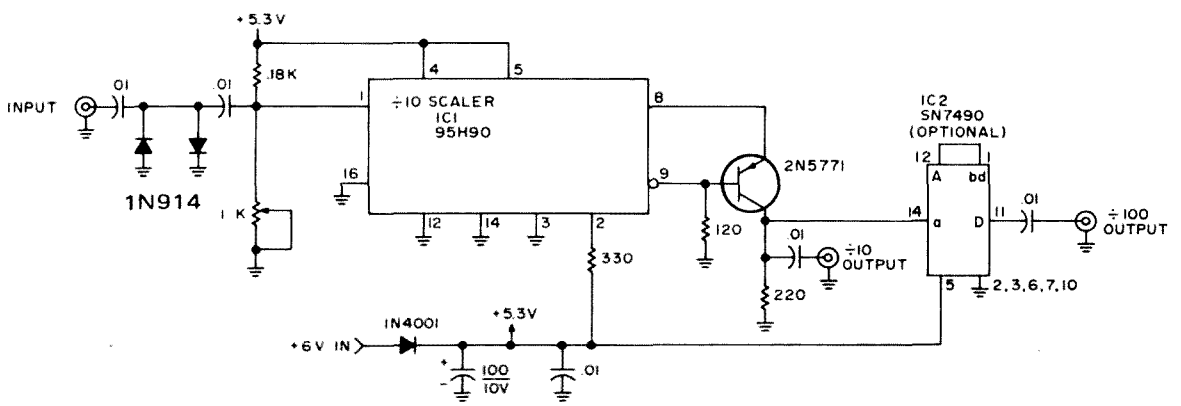
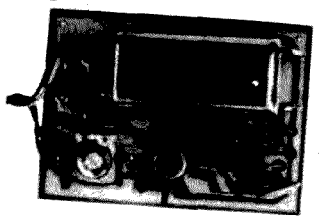


Fig. 1. VHF scaler schematic diagram. All .01 capacitors are disks. All resistors are ¼W, 10%.

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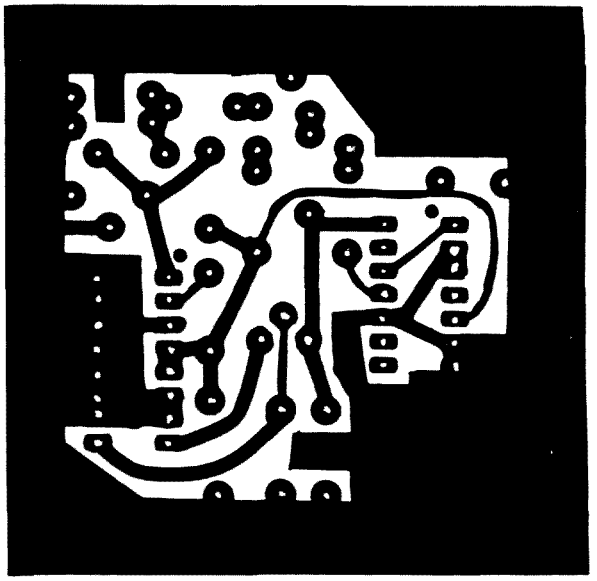


Fig. 2. Copper side of PC board, actual size.

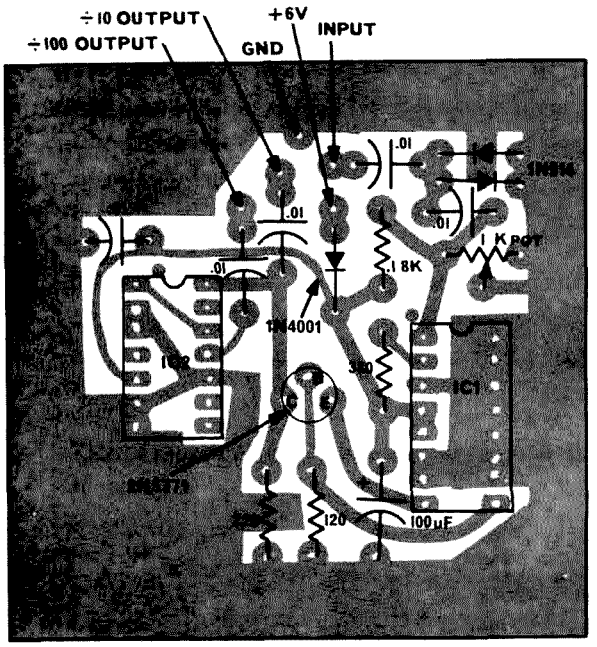


Fig. 3. Parts layout diagram (component side).

enough rf to get a counter reading. With a 19 inch length of wire connected to the input lead you should be able to activate the scaler with a 1 or 2 watt hand-held unit from a few feet away.

If you later decide to build the complete solid state frequency counter, you'll be happy to know that all the parts from the scaler will be usable for the counter later. But make sure to use sockets for the IC's (look into Molex Soldercon terminals for IC sockets).

. . .K2OAW

Ed Webb W4FQM/1
Technical Editor
73 Magazine

73 REVIEWS THE SAVOY BASSET VACUUM TRAP ANTENNA SYSTEM MODEL DGA-4075

When you open the box of the DGA-4075 you know instantly that the new Savoy Basset Antenna is made of full commercial grade parts. Quickly reading through the instructions you find that no soldering is required during assembly. All you need is a screwdriver, pliers, diagonal cutters and a tape measure. In fact you don't even need end-insulators as the nylon support line supplied with the antenna works perfectly.

Savoy supplies two very simple charts that are used to determine the length of the two sections of wire. First you pick your 40 meter center frequency to get the "A" wire element dimension. Then use that same frequency on the vertical side of the 80 meter chart. Where the 40 meter frequency and 80 meter frequency intersect on the chart gives you the second dimension for the wire sections. Now you have the two dimensions for the wire on each side of the traps. There is only one trap on each leg. The wire that Savoy supplies with the antenna is not the usual stranded type but the heavy duty copperweld solid type. Also included is a center insulator that is a broadband balun. The lead-in coax that comes attached to the balun is a half wave length on 80 meters. The feed line can even be pruned to make it an exact half wavelength at your specific 80 meter frequency. After shorting each wire element the amount shown by the frequency chart, you simply place the wire ends into the clamps on the traps and balun and tighten down the set screws – and you don't even have to strip the wire! After you have all of the wire sections together, put a support rope through the center insulator and hoist it up to the support point. Find a place to secure the nylon support ropes at the ends and you are almost ready to go. Once you run the RG-59/U feed line into the shack, the only soldering you have to do is to put on a PL-259 male coax plug along with a UG-175/U reducing adapter. That's it – all you have to do now is fire up the rig and get on the air.

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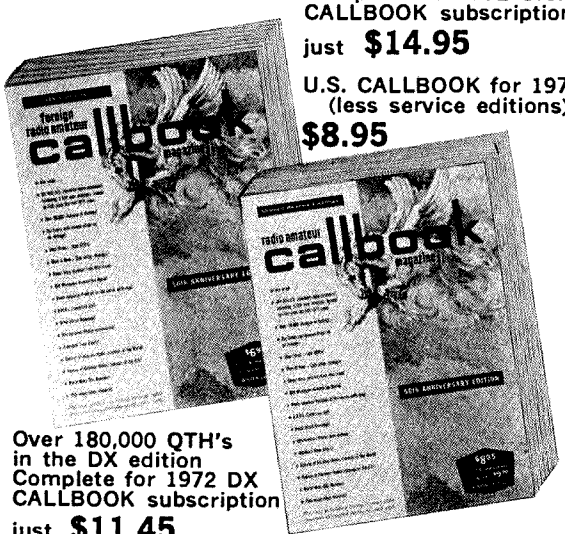
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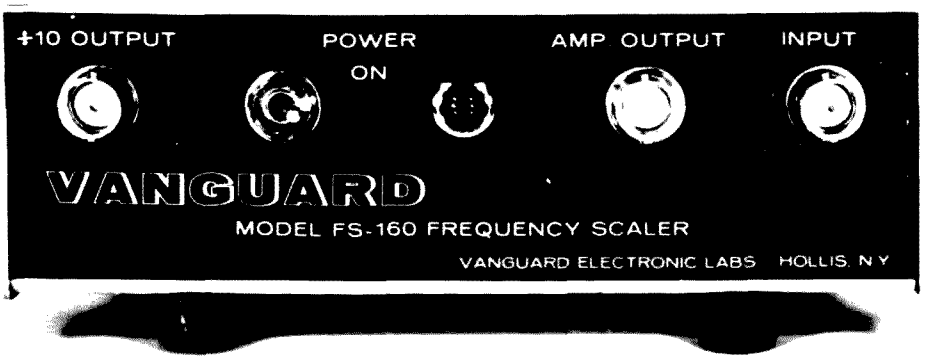
In the past I have had the unpleasant experience of trap failure on both dipoles and verticals. This usually occurred while running a full KW on RTTY. Not only would the trap go but usually the final tube, too, unless I happened to catch it very quickly. When you open the box in which the DGA-4075 was packed, you are immediately aware that the traps are quite a bit larger than the two-inch types usually found on most trap dipoles. The traps supplied by Savoy are a good four inches in diameter and are hermetically sealed in heavy, clear plastic containers. When the trap coils are placed in the containers at the factory the normal air is removed and replaced with helium. This prevents any chance of moisture getting into the traps and causing a breakdown or arc-over. The larger diameter trap coil design allows the traps to have a higher Q which means that the overall antenna performance is better.

The Savoy DGA-4075 easily withstood a full KW input on RTTY and with an SWR of 1.3 to 1 on 80 meters. In fact, I cranked the Heath SB-220 up to produce a *broadcast* type of KW and the antenna took it with no problem. The same thing was tried on phone on 40 meters with equally excellent results. In fact the antenna works so well I will probably get the conversion kit Savoy offers to convert it to be used on 20 meters as well. All you do is add two more traps and you have a high power tri-band trap dipole. Of course Savoy offers a DGA 204075 right from the factory if you want a tri-bander from the start.

I am very happy to see Savoy offer an antenna of this quality and performance – it has been long overdue for the ham who wants to run high power on the lower frequencies with one antenna. The assembly constructions are clear and concise and contain a number of examples of how the antenna can be installed in various configurations. Savoy even has reflector and director kits, should you want to make up a wire beam. The DGA-4075 is a mere $49.50 and the DGA-204075 only $79.50. Other band combinations are available. Write to *Savoy Electronics, Inc., P.O. Box 7127, Fort Lauderdale FL 33304.*

. . .W4FQM/1

Ed Webb W4FQM/1
Technical Editor



73 REVIEWS THE VANGUARD FS-160 FREQUENCY PRESCALER

In addition to the many solid state VHF/UHF preamplifiers and converters that Vanguard Laboratories make, they have entered into a new product line: a VHF prescaler. The model FS-160 is a prescaler or decade frequency divider that is guaranteed to operate up to 160 MHz. This means if you want to measure your 2m FM rig's frequency and have a counter that will read up to 15 MHz, all you need is the FS-160. The prescaler will divide your 146.340 MHz by ten and allow your counter to read 14.340 MHz. In the process of dividing you will lose the "ones" or Hertz digit resolution. It is impossible to *accurately* set a VHF transmitter to within ±10 Hz so you are not missing the performance of higher priced VHF counters. But you have gained a useful tool: you can now reset your transmitter frequency on 15, 10, 6 and 2 meters. Also the aircraft transmitter frequencies from 120 130 MHz and the business and marine frequencies from 150–158 MHz can be measured. The FCC requires your counter to be a high accuracy crystal time base so that you will meet the standards for these commercial frequencies. A first or second class radiotelephone license is required also.

By placing a short pick-up antenna to the input of the FS-160 prescaler and connecting the output to our Heath IB-101 counter, we have been able to read the frequency of hand-held portables up to a few feet away. Also, by placing the scaler and counter in the house pointing out the window to the driveway, we can very easily net the FM mobile rigs we have around. Receiver crystals can be netted on the bench by using a short piece of coax as an rf pickup by reading the local oscillator frequency in the 135–136 MHz range. This is usually 10.7 MHz below the desired receive channel frequency.

The FS-160 is all solid state with a two stage discrete wideband input amplifier and IC frequency dividers. The first IC is a high speed divide-by-two that feeds three more flip-flops arranged in a divide-by-five configuration. A discrete voltage level translator and buffer stage feed the signal to the counter after being divided by a final decade. The power supply is voltage regulated by an IC regulator controlling a series pass transistor. Input and output jacks are of the BNC style and there is a separate amplifier output jack provided. An ac power switch and pilot lamp are also on the front panel of this nice little package. Other prescalers for up to 500 MHz are also available. The FS-160 sells for $129.50. Write to *Vanguard Laboratories, 196-23 Jamaica Ave., Hollis NY 11423*

. . .W4FQM/1

CARE AND FEEDING OF TAPE

Don Royer WA6PIR
16387 Mandalay Dr.
Encino CA 91316

For those who want to keep, store and retrieve tape, there seems to be several problems that are encountered. Having had these same problems for several years with about 25 RTTY picture tapes, a few tips may be in order.

Of the two types of punches, I prefer the chad type. Even though the little chads to get into things, the tapes are easier to wind, store, and to feed into the TD. But then, most of the punches are the chadless type, so I will try to cover both situations.

There are several types of commercial winders available. I have two of them – both motor driven. One is used for winding from the TD or reperf and the other for the necessary unwinding. On a long tape, I put the loose tape from the unwinder in a large wastebasket below the TD and then forget it, as it comes out fine. Chadless tapes may catch on themselves and require a bit of watching. In the absence of a winder, you can learn to wind the tape in a figure eight about your thumb and little finger with the start at the beginning of the bundle. In this way, the tape will not be twisted and will pull off the tape bundle with but a little help from you. To keep the ends free and windable, I usually pull about a foot of blank tape from the reperf at both ends. If you are thinking of building a winder, try to keep the center hub at least three inches in diameter as too tightly wound tape resets the chads in the chadless type back where they were and will not permit it to run properly in the TD. If you use the figure eight wind, tuck the free end into the bundle loop. With rolls from the winders, I like to use a small bit of solder to hold the roll together. If you have trouble learning to figure eight wind, get a local commercial Teletype gal to show you the simple technique.

Storage and retrieval are the real problems. I separate the tapes into subjects and store them in large plastic bags with ten or fifteen tapes to a bag. This keeps the tapes from drying out and lets me find any one tape without too much time. The title of the material on the tape, marked on the lead end with a heavy marking pen, also helps to speed identification. Making and keeping a list of the tapes in the same order as stored also helps and can be used to tell the others what you may have on hand that may be of interest to them. The marking pens will also write on the plastic bags that can then be stored in a drawer or cabinet.

Sometimes when making a tape or reperfing, your supply roll will run out; or you may have a break or tear in a tape. The simple side tear problems are easily fixed with a bit of Scotch tape trimmed to the edge of the tape. Otherwise, you may need a splice or patch. These are not the best solutions, and you should make a copy tape with the repaired portion, but a fairly good splice may be made with white glue to add a fresh roll to one that is running out. Overlap about an inch or so. Be sure the glue is dry (I use my lighter carefully to hasten drying). You can also punch a short piece of tape with the same characters and splice a bad spot in the middle of the tape. With the chadless types, they may be merely run together in the TD to hold the splice. But if you want to keep the tape for any time, take the time to make a new one.

When running a long tape on the air, don't forget the need to ID at least every ten minutes. If you have the narrow shift CW ID facility, that is fine and will lock up most of the machines. In the absence of the narrow shift (about 100 cycles), stop the TD and let the steady mark tone stay for a few seconds, then CW ID and repeat the steady tone to permit the other fellow to hit his standby switch and not interrupt his print. When making tapes, do make them as short as possible and leave out all those lines across the paper that are in some brag tapes, the "CW ID follows" bit and similar unnecessary characters or language.

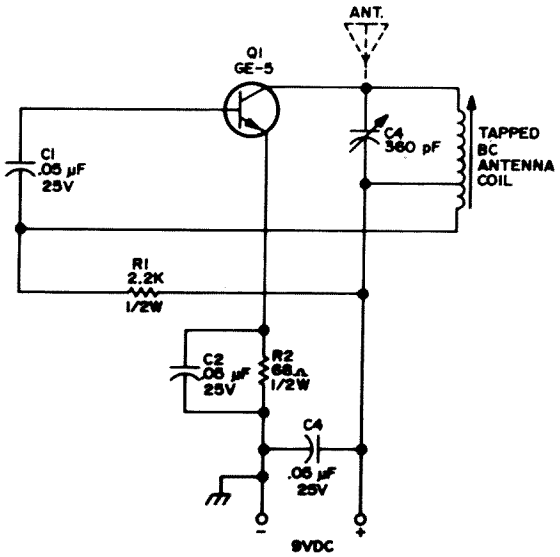
So get all that tape off the floor, men. You may even find something you lost long ago.

. . .WA6PIR

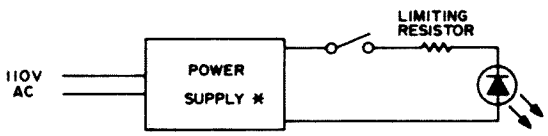
CIRCUITS, CIRCUITS, CIRCUITS...

The following circuits have appeared in the referenced books, magazines, application notes, etc. While we try to reproduce all of the information that should be needed by an experienced constructor, readers may want to avail themselves of the original sources for peace of mind.

Readers are requested to pass along any interesting circuits that they discover in sources other than U.S. ham magazines. Circuits should be oriented toward amateur radio and experimentation rather than industrial or computer technology. Submit circuit with all parts values on it, a very brief explanation of the circuit and any additional parts information required, give the source and a note of permission to reprint from the copyright holder, if any, and the reward for a published circuit will be a choice of a 73 book. Send your circuits to 73 Circuits Page, 73 Magazine, Peterborough NH 03458.



Beat frequency oscillator (courtesy of Gerard Piette, Ontario, Canada). Place unit near receiver and tune C2 until SSB and CW signals become intelligible.



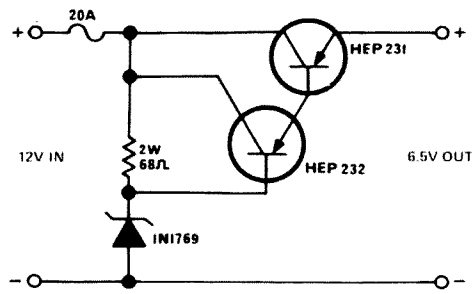
* IF POWERED FROM THE AC LINE, THE OUTPUT MUST BE 6 VAC (STANCOR TRANSFORMER NO. P8385 OR EQUIV). OTHERWISE, POWER SUPPLY IS 6 VDC AT 100 mA.

LIMITING RESITOR CALCULATIONS

$$\frac{V_S - V_F}{I_F} = R \text{ (min.)}$$

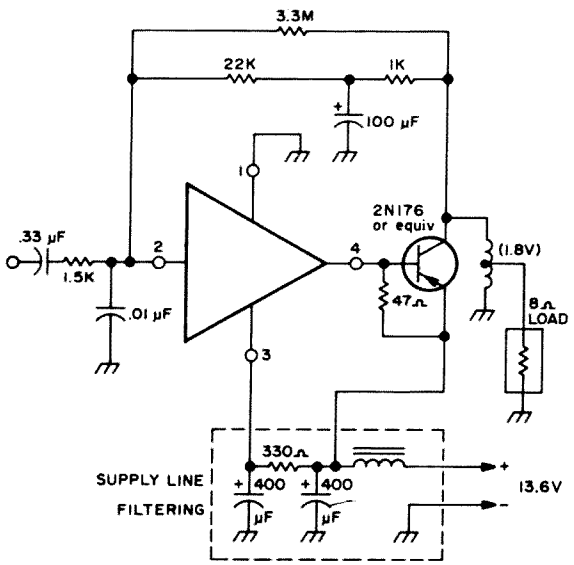
V_S = SOURCE VOLTAGE
V_F = LED FORWARD VOLTAGE
I_F = FORWARD CURRENT
R (min.) = VALUE OF RESISTOR (in ohms)

The power requirements for light-emitting diodes are very low and the devices may be operated from a variety of power sources. However, it is necessary to limit the current to an LED, since, like a neon lamp, it can be damaged if permitted to draw excessive current. The simple formula will help to determine the correct resistance value. Courtesy Sprague Products Co., L.E.D. Application Notes.

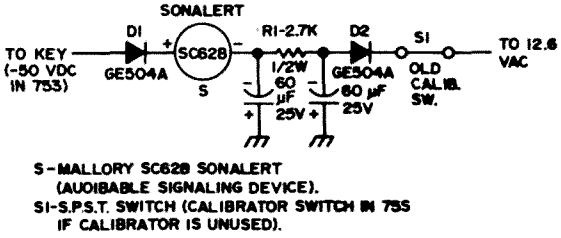


12 to 6 Converter

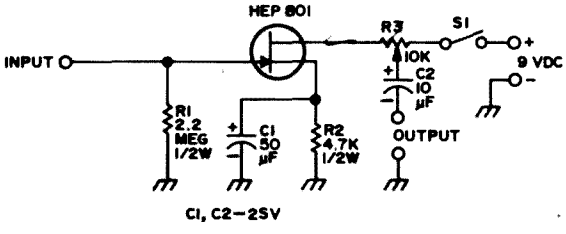
You say you got a real bargain on an old motorcycle FM rig, only to find out it was 6 volt? Fret no more. Below is a handy-dandy 12 volt to 6 volt converter unit, courtesy of KØWRL, which is suitable for low and medium powered gear. The transistors should be mounted in a suitable heat sink. From Grid Leak, Pueblo, Colorado.



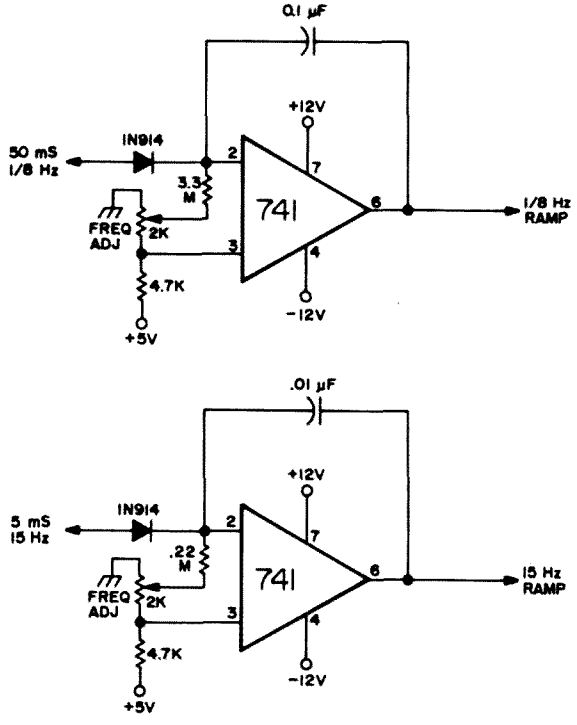
Typical 4 watt amplifier circuit application of a Motorola MFC4050 silicon monolithic functional circuit, a Class "A" audio driver designed for driving Class 'A" PNP power output stage applications. Circuit courtesy of the Motorola Functional Circuit Handbook.



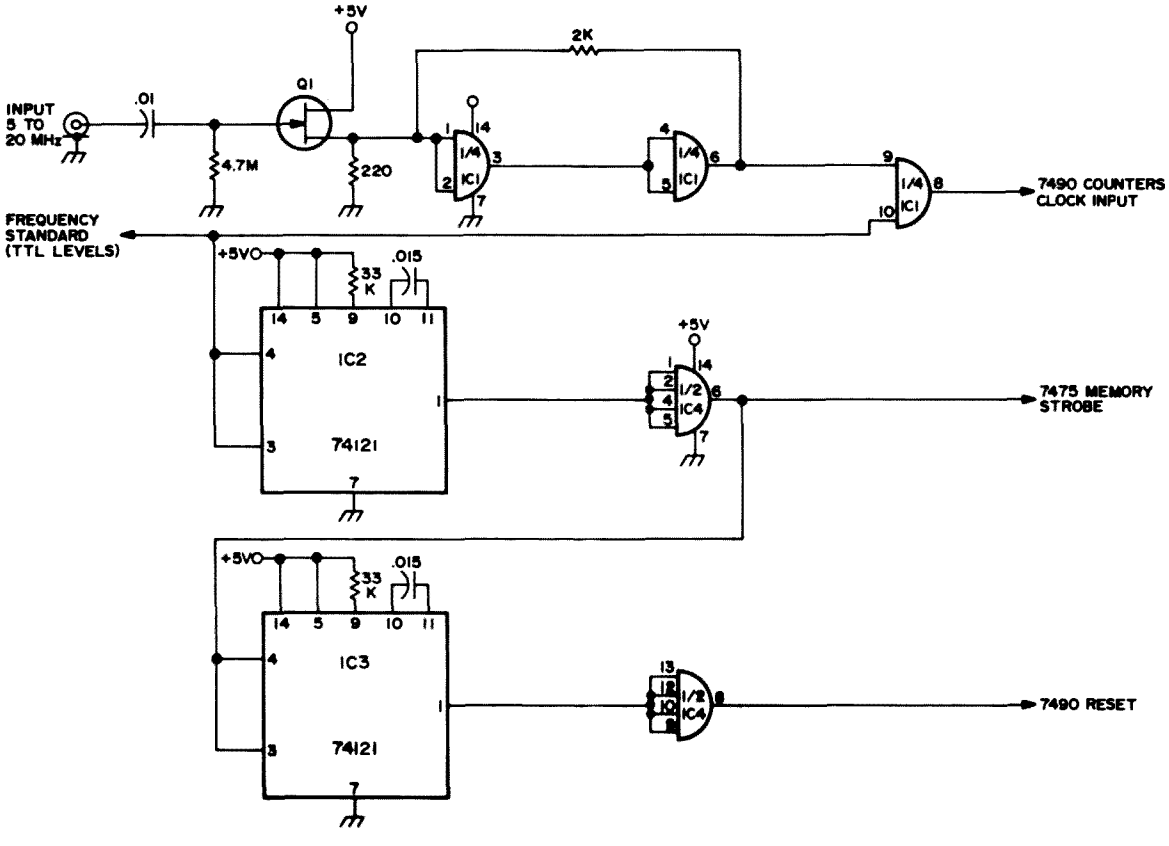
CW sidetone using Mallory SC628 Sonalert. For positive key voltage, reverse all polarities. (Thanks to Alex Szablak, New Hartford NY.)



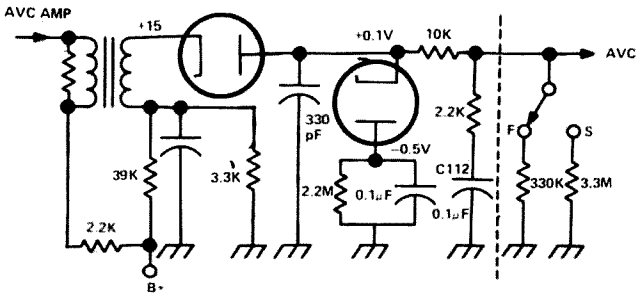
Microphone preamplifier. Mike output low? Fix it with this one. This is for use with a ceramic or crystal microphone or even a phone cartridge. Circuit courtesy Motorola HMA-33 Tips on Using FETs.



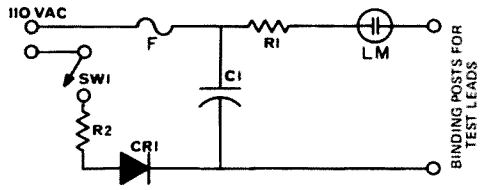
SSTV ramp generators. This circuit will give an extremely linear ramp for SSTV monitors, cameras, and flying spot scanners. The voltage varies from ≈ -10 to +10. A positive going pulse of +2 to +5V amplitude resets the ramp for the next sweep. (Thanks to WØLMD)



Frequency counter input: gating, strobing and resetting. The sensitivity is set by the ratio of the 220 to 2K resistors. (Thanks to WØLMD)



AVC modification for better SBB reception with the Collins 75A4 that lets you leave the rf gain wide open. It gives much longer AVC time constant and prevents audio "pumping" on speech. Change C112 from 0.1 μF to 1.5 μF mylar, 100V.



When testing a capacitor, the light will blink once or twice while the plates are loading and then will remain off. If the capacitor is not good, the light will continue to blink.

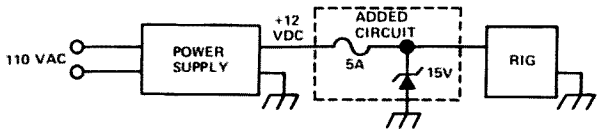
When checking capacitors wired into circuits, one end must be disconnected.

R1 – 47K 2W resistor, R2 – 330K 2W resistor, LM-1 – Neon lamp NE 51, C1 – 8 or 10 mic capacitor 450V dc, CR1 – 1M3611 diode (not critical), SWL – ST toggle switch, F – ¼A fuse.

From the Colorado/Wyoming MARS Newsletter.

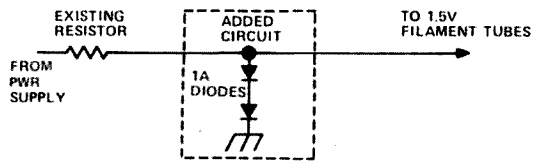
FOR YOUR OWN PROTECTION

Since everything fails at some time or another, thought should be given to what would happen to one of those solid state transistorized rigs should the line operated 12V supply fail. Many times when a supply fails, the output voltage rises to much greater than 12V. The results, as you can imagine, are disastrous, as several people have discovered. Therefore the following circuit is recommended to be used whenever operating from any non-battery supply.



The zener should be at least 1W and preferably 10W.

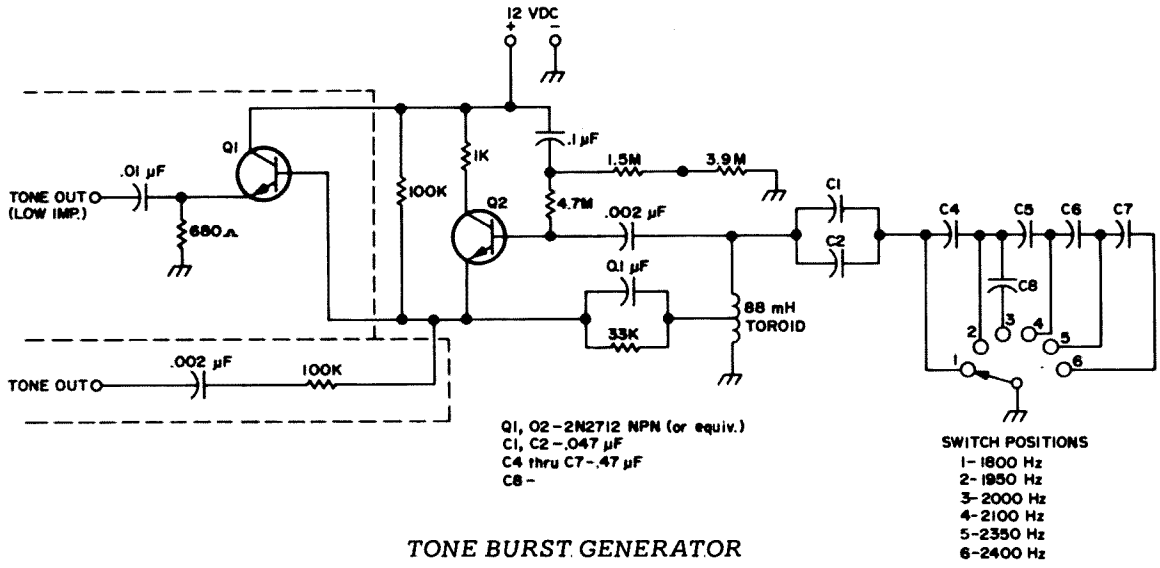
Along these lines, the following circuit can help to greatly prolong the life of filament type tubes in appropriate sets (H23, P33, MRT-9, etc.) when operating from supplies other than dry batteries. Some sets have two limiting resistors or balast tubes, one for receive and one for transmit. In this case, two of these diode sets must be used.



Circuit by Alan Tasker WA1NYR, reprinted from WA1KHB MRA Newsletter.

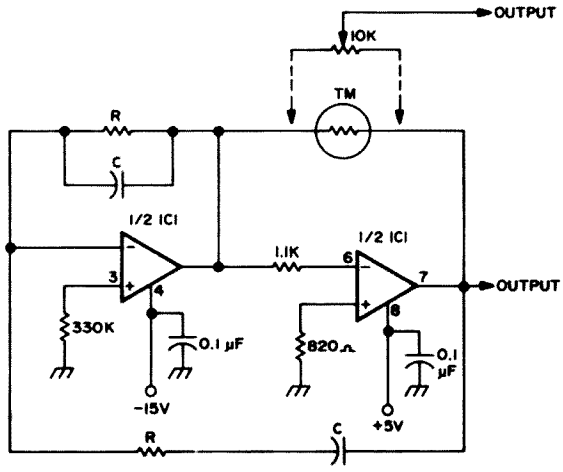
VHF/UHF Antenna Measurements

Frequency	¼ wave Free Space	¼ wave Antenna	¼ wave Radial	½ wave Free Space	½ wave Antenna
50 MHz	59.1'	55.5"	66.1"	113.1"	111.0"
50.5	58.5	55.0	65.6	116.9	109.9
50.5	58.5	55.0	65.6	116.9	108.8
51	57.9	54.4	64.8	115.9	106.7
52	56.8	53.4	63.6	113.5	105.7
52.5	56.3	52.8	63.0	112.5	104.7
53	55.7	52.4	62.4	111.5	102.8
54	54.7	51.4	61.2	109.5	38.5
144	20.5	19.3	23.0	41.0	38.3
145	20.4	19.1	22.8	40.8	38.0
146	20.2	19.0	22.6	40.4	37.8
148	19.9	18.8	22.3	39.9	37.5
220	13.4	12.6	15.0	26.8	25.2
221	13.4	12.6	15.0	26.7	25.1
222	13.3	12.5	14.9	26.6	25.0
223	13.2	12.4	14.8	26.5	24.9
224	13.2	12.4	14.8	26.4	24.8
225	13.1	12.3	14.7	26.2	24.7
435	6.79	6.33	7.60	13.58	12.76
440	6.71	6.31	7.52	13.42	12.62
445	6.64	6.24	7.43	13.27	12.47
450	6.56	6.17	7.35	13.12	12.34



TONE BURST GENERATOR

Tone-burst entry is becoming increasingly common as a requirement – repeaters in many parts of the country now require anything from 1800 Hz to 2400 Hz for entry. The circuit above is for a tone-burst generator to meet these requirements. Circuit courtesy of the Central Ohio Radio Club FM News, September, 1971.



TM - THERMISTOR, VECO 35C1 or equiv. (5K COLO)

$$f_{OUT} = \frac{1}{2\pi RC} = \frac{.159}{RC}$$

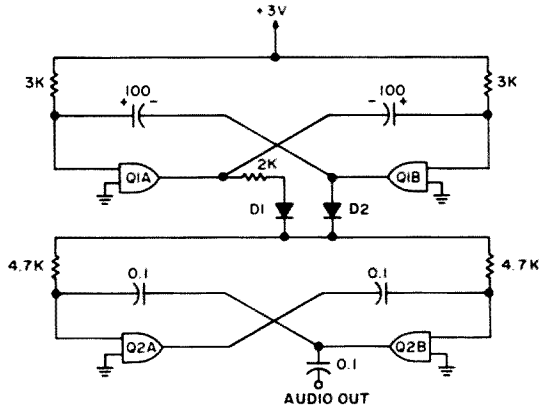
IC1 - MC1458P

A SIMPLE SINE WAVE GENERATOR

There are several applications where a good pure sine wave is useful such as a two tone test device for sideband rigs, sending CW with a phone only rig, etc. The Wien bridge circuit is one of the best and simplest methods of getting a good sine wave. In most Wien bridge oscillator circuits using integrated circuit op amps, very small values of R had to be used in the bridge because of the low impedance inputs of these devices.

In this circuit, the parallel branch of the bridge is connected from the inverting input to the output of one of the two op amps; thus it sees a very high impedance. The amplitude control is shown as a bead thermistor; however a 10K pot could be substituted as shown or any other method of output level countrol could be used. For a frequency of 1 kHz, R=330K and and C=470 pF.

The Motorola MC1458P, National LM1458, Signetics N558V and TI SN72558P are all identical and may be used above with no modifications. The Fairchild µA747 may also be used but leave the offset null terminals open. Two 741's are also suitable. If you use 709's you may have to include frequency compensation as all of the above mentioned IC's are internally compensated. (Circuit by Roger WB6ESP, reprinted from The Footprint, Foothills ARS, Mountain View CA.)



D1,D2 = 1N34 or other germanium.
Q1,Q2 = µL914 or equivalent.

Circuit shown above provides a square wave output from Q2 whose audio frequency is changed alternately by action of multivibrator Q1. The resulting warbling note provides an excellent burglar alarm or hidden transmitter signal. Circuit submitted by J.F. Walker W6GNL.

A. C. Spraggins W5EZM
Box 7152
Austin TX

ELLIPTIC FUNCTION FILTERS FOR RTTY

Most newcomers to radio teletype encounter similar types of problems which they experienced in single-sideband and CW signal reception. One such problem is that of selecting the desired signal from the unwanted noise in the channel through the use of suitable filtering.

The purpose of this article is to provide design information that will enable the average amateur to build a good set of channel filters for RTTY at modest cost. The filter to be described was chosen because of its inherent sharpness and ease of tuning. Other design configurations, such as the Butterworth and Tchebycheff, have been used successfully but perform less satisfactorily than the elliptic function type when it comes to skirt steepness.

The sharper skirt characteristic is readily apparent when the two types are compared as exhibited on Graph 1. Shape factor and band width help to maximize the signal-to-noise ratio. The graph compares the six-pole Butterworth filter described in *RTTY*

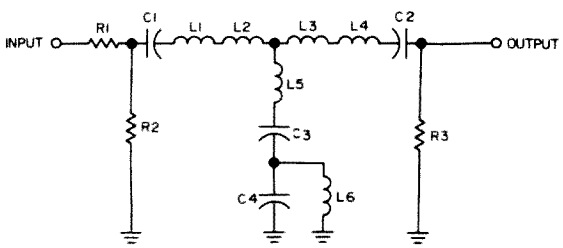


Fig. 1. Elliptical function filter.

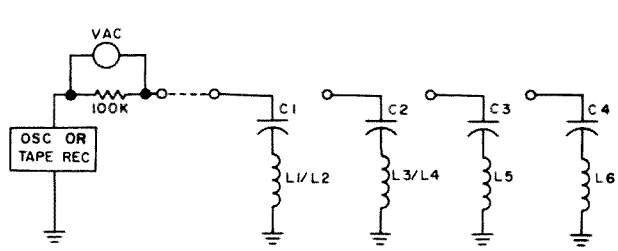


Fig. 2. Test jig for tuning filter elements.

TABLE 1

Frequency	C1, C2	C3	C4	L1-5	L6	R1, R3	R2
2125 Hz	.032	.072	3.3	88	1.67	150	200
2295 Hz	.028	.047	3.0	88	1.80	150	200
2550 Hz	.025	.047	3.2	88	1.24	150	200
2975 Hz	.017	.034	3.5	88	0.81	150	200

Capacitors are in microfarads
Inductors are in millihenrys
Resistors are in Ohms

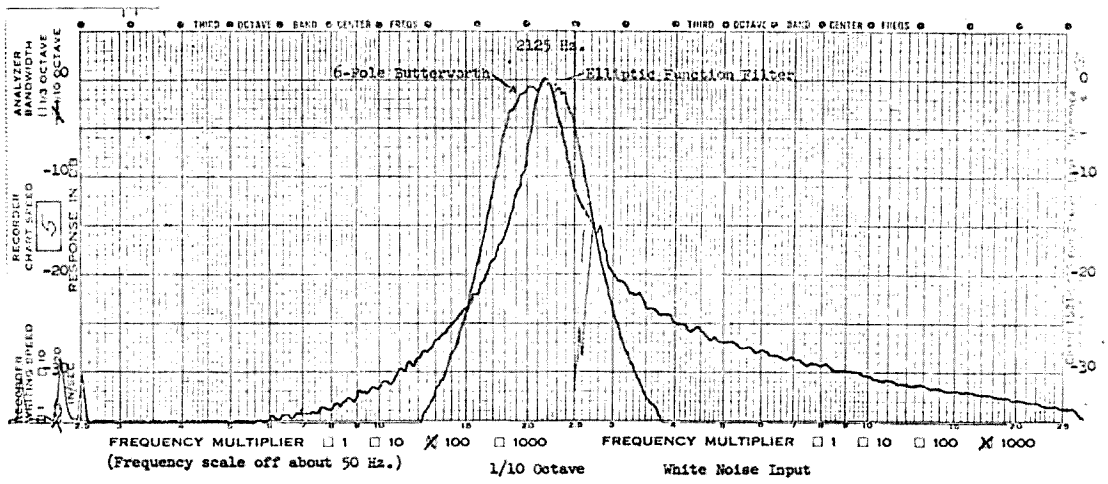
Journal, November, 1966, with a four-pole elliptic function filter of modern design.

There are basically two types of terminal units in use by amateurs. One type employs a linear discriminator while the other uses a clipper or limiter circuit. A narrow-band filter offers only about 1 dB improvement over a broadband filter when used in a discriminator type terminal unit. If a terminal unit uses a combination of both an FM and a linear system, then the narrow-band filter is the most desirable as the linear system is enhanced by its use.

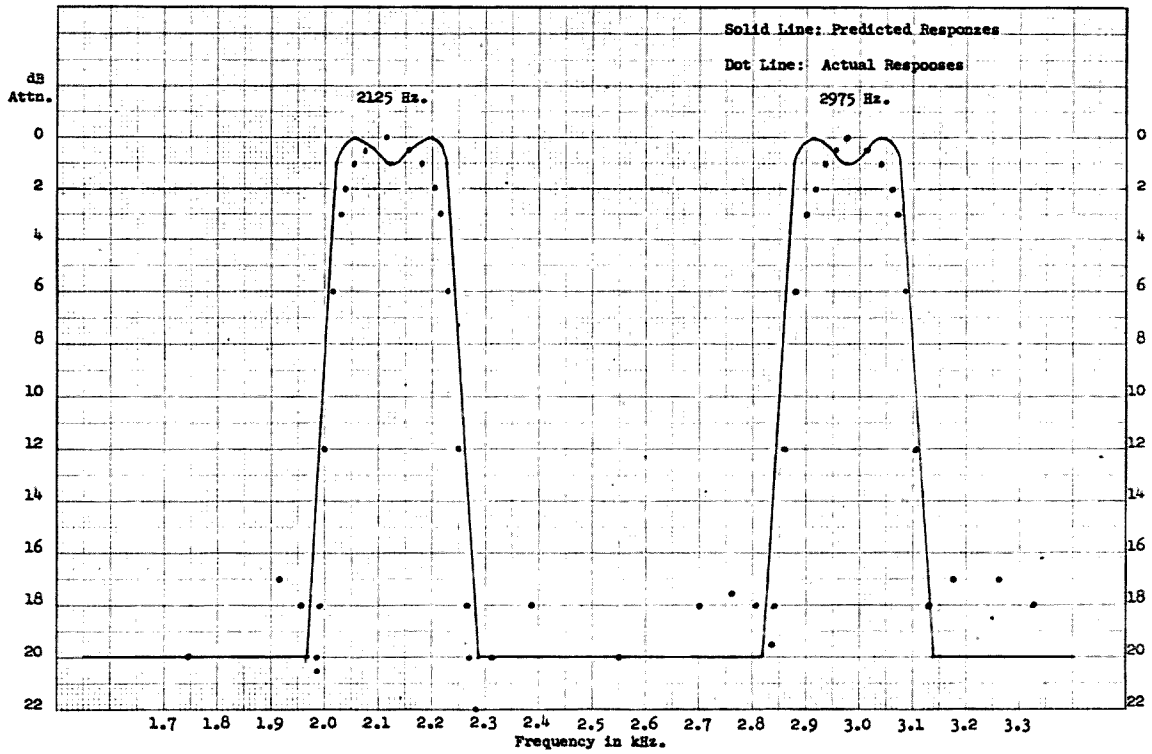
A linear system works best on single or dual channel copy when the signal is exhibiting a slow multi-path fade. The limiter type system responds best to signal flutter or quick, shallow fading to which the limiter seeks to maintain a constant level of output.

Construction of Broadband Filters

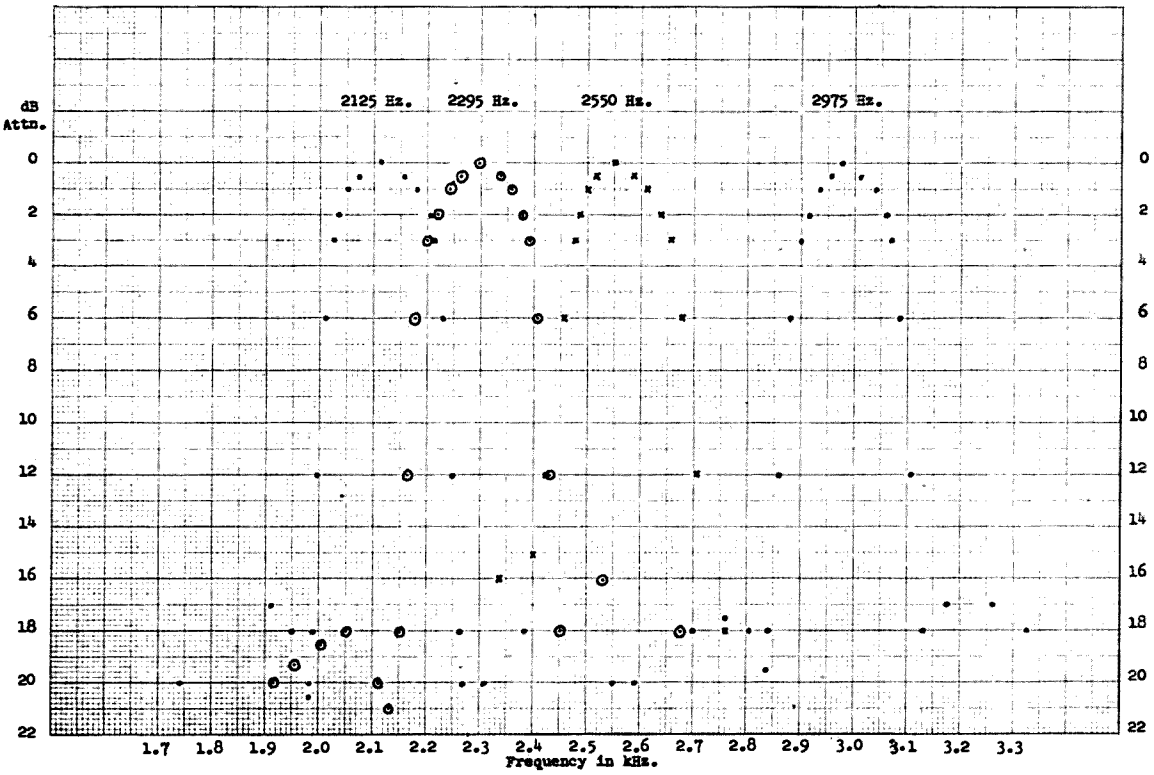
For some reason, there is not too much specific information available on RTTY filters for amateur use. Digital and other types of active filters are being designed from time to time but their cost and more involved circuitry usually tend to make amateurs rely on the simple passive types of filtering. The article in *RTTY Journal* provided the impetus for me to duplicate the filter set employed in the AN/FGC-1 military terminal unit. Sufficient test equipment was available to accurately measure the response of the constructed filters with a net result of remarkable adherence to the response curves provided. This was gratifying, to say the least, as there were many difficult component values to "bridge out." The filters were constructed on Vectorboard using 88 mH torioids in series to provide the large inductances which were required. The resulting 850 Hz broadband filters offered a good start toward a respectable terminal unit. The major drawback to using the filters is that considerable operation today is on narrow shifts of 170 Hz or 425 Hz. For this reason the construction of a new set of narrow-band filters was begun..



Graph 1. 6-pole Butterworth compared with a 4-pole elliptic function filter.



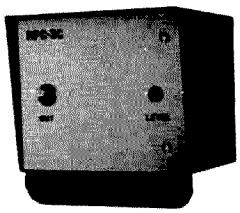
Graph 2. Predicted responses and actual responses of 2125 Hz and 2975 Hz filters.



Graph 3. Actual responses of all four filters.

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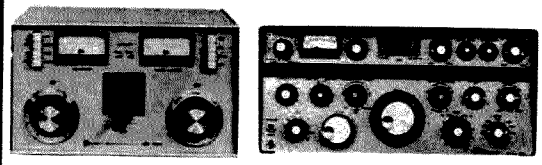


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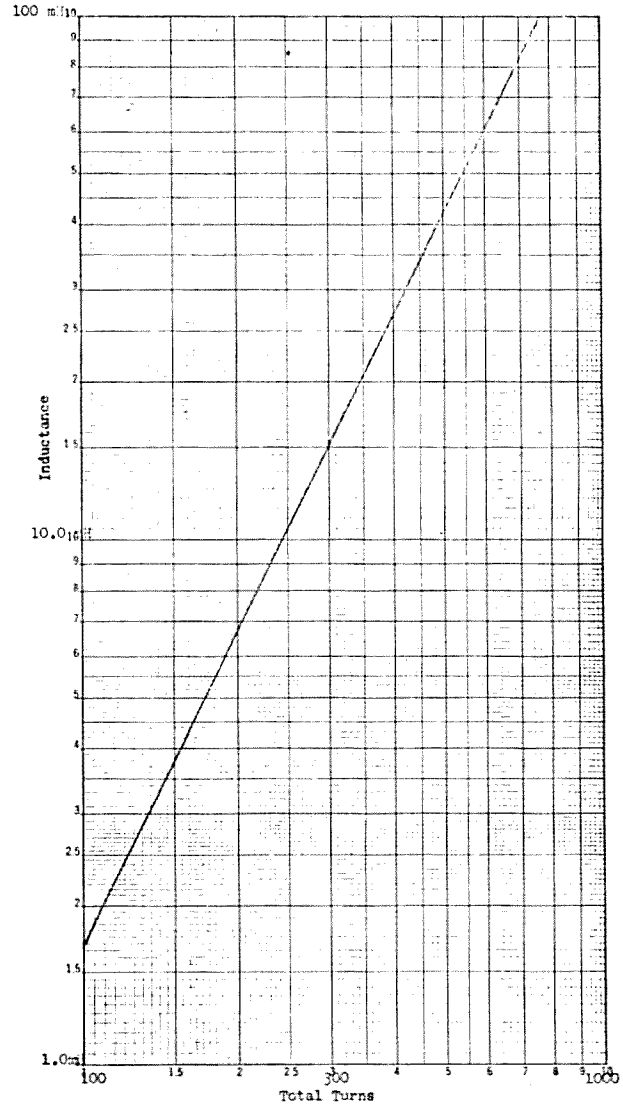
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Designing Elliptic Function Filters

One of the best sources of filter design information is found in "Simplified Modern Filter Design" by Philip Geffe. A computer was used to derive tables provided in Geffe's book which greatly simplified the calculations involved. The simplest and sharpest elliptic function filter was selected and the design was made with due consideration given to the availability of parts.

The basic design of the elliptic function filter is shown in Fig. 1. All of the filters for 2125 Hz, 2295 Hz, 2550 Hz and 2975 Hz, use this configuration.

The equation used predicted a 1 dB ripple in the passband and 1 dB down on the slopes at 200 Hz wide. The actual lack of ripple in



Graph 4. 88 mH toroid: approximately 168 mH/1000.

the passband of the constructed filters may have been caused by insufficient Q. The predicted response curves for the elliptic function filters are shown in Graph 2. This graph has the response plotted for two filters with 850 Hz separation, namely 2125 Hz and 2975 Hz. Equally sharp responses were obtained for the 2295 Hz and 2550 Hz filters. Also shown on Graph 2 are the actual curves of the constructed filters. A frequency counter and ac voltmeter were used to accurately plot the responses. As can be seen, the actual filter responses were slightly narrower than the predicted responses. This presents no serious drawback to the system, however.

Narrow-band filters will not tolerate much signal drift but with today's modern receivers and afc circuits, drift is greatly minimized anyway. Parts layout is not critical but good quality capacitors must be used throughout the circuit or serious degradation of the response will be experienced. Do not use electrolytic capacitors.

Table 1 indicates the values of components required for each filter. Some padding of the standard values will have to be done to obtain the values shown.

The Ubiquitous Toroid

The 88 mH toroid inductor was employed wherever possible because of its acceptable Q and low cost. Only one inductor in each filter is not the standard 88 mH value. This is not too serious a problem, however, as will be shown later. Several 88 mH toroids were measured on a General Radio Impedance Bridge. The average inductance was calculated to be 86.8 mH. Further measurement indicates that the core of the 88 mH toroids has a permeability of approximately 168 mH per 1000 turns. This means that, by using logarithmic graph paper, a simple method of determining the number of turns required for a particular inductor can be achieved. A graph is presented for those amateurs who may find the information helpful in building the elliptic function filters or other filters.

Tuning the Filters

The most efficient way to tune each filter would be to use a calibrated frequency



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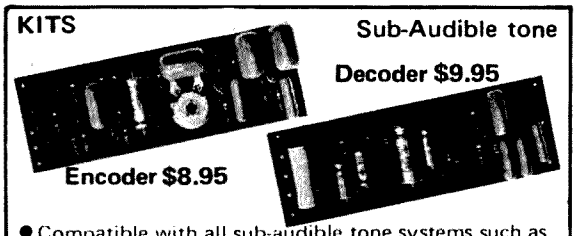
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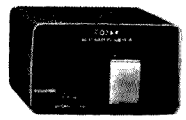
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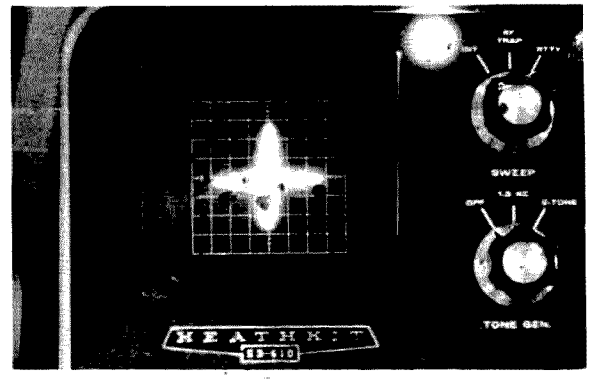


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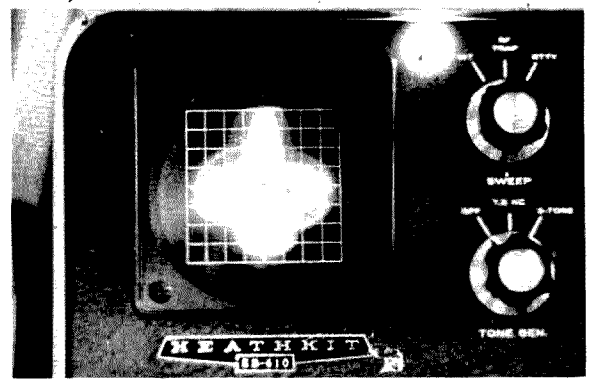
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(a) 4-pole elliptic function filters (200 Hz narrowband).



(b) 6-pole Butterworth broadband.
Fig. 3. Oscilloscope patterns.

generator and counter, along with a sensitive ac voltmeter. Not all amateurs have access to such equipment, but with a little resourcefulness, good results can be obtained. Try to find someone with a calibrated oscillator who will tape record about a foot or so of each desired frequency. Make a continuous loop out of each foot-long tape and play back the tape while feeding the tape recorder output (4Ω) into the filter circuits being tuned. Using the method shown in Fig. 2, tune each combination of elements to the desired center frequency. This will be indicated by a *peak* in the output level. Removing a few turns from each inductor may be necessary to get exactly on frequency. Padding with capacitors is much more difficult to do and the slight change in inductance won't severely affect the filter impedance.

Termination of Impedances

The input impedance of the filters is designed to work from the 4Ω speaker output of most receivers. A 600Ω receiver output may be connected directly to the

filters by eliminating R1 from each filter. The output impedance is 150Ω. These impedances were chosen because of the desire to use the standard 88 mH inductors. Different impedances will require different inductors. There is about a 6 dB loss through the filters. Amplification may be required between the filters and the terminal unit if diode rectification is to be used.

Results and Findings

A comprehensive graph of all four filters is shown in Graph 3. It can be seen that the minimum channel separation between the 2125 Hz and the 2295 Hz filters is approximately 3 dB. Separation between other combinations of filters approaches 20 dB.

Oscilloscope patterns in Fig. 3 compare the familiar cross patterns used for tuning in a typical RTTY signal. The Butterworth filter pattern has a more oval shaped trace while the elliptic function filter pattern is almost a straight line. The Butterworth broadband filter allows more noise into the channel which may capture a limiter or otherwise interfere with the signal.

Conclusions

Good, sharp, narrow-band filters for RTTY can be constructed by the average amateur using inexpensive components and having limited access to sophisticated test equipment. Simple duplication of the theoretical filter design should yield the results obtained in Graph 3. More complicated designs will offer better solutions to signal-to-noise problems. This will no doubt increase the cost of constructing such filters and complicate their tuning. The lack of access to sufficient test equipment may preclude most amateurs from attempting to build such devices. There should, however, be continuing research performed in these areas by amateurs for amateurs.

There are four persons to whom I am indebted for their assistance in making this report a reality: Richard G. Coalter for his engineering talent, Dennis M. Pierce for his report-writing skills, Vicki Spraggins for her typing and patience in retyping, and Eric Sager for making me find the time to get it all together.

. . .W5EZM

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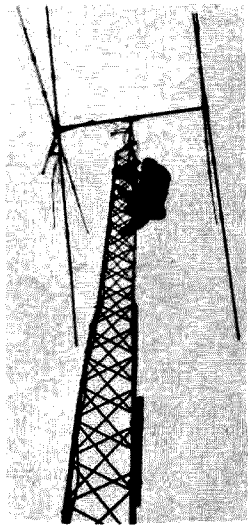
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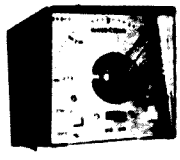
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Step on the KLUTZ i

The question, "What's 'he' (meaning me!) doing in a 'ham' magazine?" is quite often asked.

The answer? Simple, really! Amateurs aren't all transistors, antennas and microfarads. They are real, honest-to-goodness individuals. They're interesting, inventive, sincere and ofttimes very funny people!

Some amateurs are electronic wizards, others are dexterous with key, bug and mill or have the unique ability to converse endlessly on a myriad of subjects and, of course, as in other fields, some are *klutzes*.

Every ham possesses some of these qualities – only the degree of proficiency varies.

When a ham blossoms forth, he becomes an authority in that area in which he excels and, as an authority, has a right to be heard and discussed.

Those of you who have followed my literary gamboling from "In the Beginning" to "Bob, Bob, Bobbin' along" know that I derive my material from personal experiences, and my forte is that I'm a *klutz*!

My soldering iron either refuses to melt the solder or sets fire to the whole damned bench, my hot-melt glue-gun delights in oozing glue onto the floor in a messy puddle to which my feet seem to be irresistably drawn (on at least two sticky occasions I thought I was paralyzed). Right now – as mute testimony to this fact – there are two shoes, an old sneaker, and one argyle sock stuck to the floor under my work bench.

At the operating position, my earphone-microphone always precedes my tongue into the coffee cup and the lumps on my forehead from banging into desk tops while reaching over for dropped articles are legendary.

On RTTY I say, "Hold up – gonna change ribbon!" I reach in my hand only to retrieve it with "RGR OM" stamped indelibly on my thumbnail.

In public, someone seems always to be just milliseconds ahead of me either causing spring-loaded doors to whomp me into semi-consciousness, or they've just stopped their dogs – leaving a meadow muffin – in the exact spot where I, in less than 1.5 seconds, will put my size 10 clodhopper.

Spray cans are my particular nemesis. If the can rattles before my wrist atrophies and the nozzle doesn't clog, then I somehow manage to reverse the spray head sending half a can of black lacquer or *Raid* up my sleeve. I've got a dozen shirts with dazzlingly colored right sleeves, my underarm looks

like the NBC peacock and I can exterminate half the bugs in New England with a single salute!

Those of you who use typewriters know how easy it is to stick your fingers between the keys, but have you ever gotten a digit firmly stuck there? I have! Had to wrap that 50 lb Remington up in a baby blanket, fasten a mock nursing bottle near the top, and smuggle myself into the emergency room – mumbling to interested onlookers that the 'baby' has colic.

Then, in the examining room when I remove the blanket, exasperatingly jabbering an unheard explanation to a doctor, nurse and several corpsmen – all of whom are doubled up in helpless, convulsive, hysterical and tear-spilling laughter – as to how it all happened.

Okay, so you can send and receive 35 wpm or build a heat-activated 2 KW SSB transceiver no bigger than a match head. Well, I'm a *kultz*! That's my specialty – pure and simple. Who, then, is better qualified to point out the absurdities in hamdom than I?

My warped sense of humor only complicates the situation. I'm not intentionally sacrilegious – it just happens. Example: You're familiar with the phrases, "right 'hand' man," "The 'voice' of America," that police use 'leg' men, that reporters have a 'nose' for news. Fine. Now how about the ham magazine that bills itself as an "Official Organ?" I apologize, but every time I see or hear that phrase, my cracked psyche never fails to conjure up a giggle-producing mental picture. What's an "Official Organ?" The hams' ambassadorial stand-in stud with portfolio, sash and badge perhaps?

Based on the foregoing, I can assure you that the next few pages will definitely not be devoted to laborious and somewhat dubious methods of converting your toaster, sump pump and/or athletic supporter to 2m FM; nor will it render any advice on CB rig modification (albeit, I do have some poignant – if somewhat improbable – suggestions on what could and should be done with those over-modulated, 23-channeled, 27 MHz miscreants but I'm somewhat reluctant about openly diagramming them. The last time these anatomically improbables were expressed, they unintentionally influenced a contortionist who, as a result, not only filed a paternity suit, but billed me for postpartum care and I became the unwilling godfather to a cesarean Johnson Messenger II. I don't know what the guy was complaining about – what with the built-in mini-whip he had a perfectly functional curb feeler, paper-picker-upper and midget stabber.)

Neither will my latest literary faux pas delve into the realm of 'gimmicks.' For, to me, the only authentic "Automatic Nut Starter" is the jerk who hands a microphone to a Citizen Bander!

Before you jump to any erroneous conclusions, let me assure you that I have nothing against CBers – per se – even though it has been said that it would be apropos to define gross incompetence as a herd (a mob has a leader) of Citizen Banders armed with screw drivers. Anyhow, anyone who's unfortunate enough to have his tongue and colon joined so closely together deserves understanding, not criticism! I won't comment on the quote uttered by one learned gentleman who stated that a ham was nothing more than a Citizen Bander who had discovered a second use for his fist! . . . ah, well.

This article will consider the inane object, "Why does society view hams through traumatic and jaundiced eyes in much the same way that would observe an anti-social and not-quite-housebroken hippopotamus?" The *klutz* factor seems to overshadow all else.

Experience has taught me, after having it mentioned on several diverse occasions – which resulted in my being stepped on by Gentle Ben, kissed by a yeti, tossed summarily out of a friendship club, deliberately run down by a Welcome Wagon and mugged by a Good Humor Man wearing a peace symbol – that you should never voluntarily admit that you are, indeed, a ham!

[Small aside: Rapid calculation with my 98¢ Magi Brain Calculator shows that hams comprise only 1/1000th of the population. This makes us a very minor ethnic group whose acceptance by society would be greatly advanced if there were more hams.]

Therefore, I block-letter crayoned a brief note to the FCC urging "LOWER YOUR REQUIREMENTS!" to which they replied, "UP YOUR FREQ!"

Certainly anyone who's been a radio amateur for any length of time is all too familiar with the warning signs that precede the announcement that you are unacceptable. However, for those who aren't familiar, *beware*!

The first, most common and easiest to recognize reaction to hams by non- or anti-hams is an apoplectic facial contortionistic look – or GAWK – of sheer horror. Picture if you will Harry Greedy-Gut at a buffet supper, one hand full of canapes, the other clutching cookies. Spying some new delicacy he gulps down the canapes and reaches for the newest goodies, only to find that he has inadvertently swallowed someone's pocket watch. In frenzied horror he'll 'drop his cookies' and his expression will reflect unbelieving shock which will decrease only with the passing of time.

Chance observances like this are rare to witness and are, for all practical purposes, indescribable. The GAWK can, under certain controlled environmental circumstances – and only for familiarizational purposes – be closely simulated.

You can, for instance, don a tri-colored beanie, replete with propeller – grasp a full grown, malodorous and recently agitated polecat by the tail, wave it over your head and, with a purple popsicle stuck in your left ear, stomp through the largest department store in town plucking a three-stringed swinette and humming the first eight bars of "I Wanna Be Loved By You!" – or –

You can dash stark naked into a meeting of the local D.A.R., screaming "I'm a reincarnation of Paul Revere! Where's my pot? The guy in the steeple was a pyromaniac. One if by land, two if by sea; one lantern two lanterns; land-sea-air, hell! I don't know who or what's coming 'cause he burned down the whole ruddy church!" Then, slithering up to the chairwoman, whisper, "Ya know John Paul Jones was a Russky, Ben Franklin was a bookmaker and Johnny Appleseed was a litterbug . . . "

It may well be that because I am the titular head of a household comprised exclusively of anti-hams I've become overly sensitized – perhaps, as a *klutz*, I bring it on myself.

Gorgo, my XYL (Miss Vitriolic 1939–46), firmly believes that hams, left-handed pitchers and out-of-State drivers are all self-made men who (though perfect models, providing someone wanted to mold an idiot) quit work too soon and had nothing to work with except a superabundance of silly putty and chitlin's. That they would, therefore, join the nearest and most readily accessible chapter of W.O.W. (Witless Old Winos – not a bad group, actually. They send a bottle of Muscatel, a can of sterno or a jug of Aqua Velva with a slice of bread to a friend on Prohibition Repeal Day – it's called a Win-O-Gram!)

Although my crumb-grabbing, curtain-climbing jam-handed vidiot harmonics think it's great fun to invade my shack and in my absence steal pencils, paper and, in short, give the place the appearance of having been hit by several Molotov Blivets, they, at the tiniest flicker on any one of our mandatory 36 TV sets, set up a screaming wail of "Daddy's doin' it again – he's screwin' up Bozo" that can be heard for miles.

This disrespect is not the exclusive property of homo sapiens. It is shared, on at least a part-time basis, with the animal kingdom. I'm not too sure about inanimate objects yet, but I swear I've been karated by doors, tripped by tables and maliciously attacked by the recliner/rocker although Gorgo says that's foolish 'cause the recliner and I are totally compatible since we're both slightly off our rockers.

The Manning menagerie presently consists of a Mynah bird, a poodle, two Siamese cats and assorted fish, bugs, newts and . . . I dunno . . . just things!

While I am constantly being bitten by bugs, hissed at by snakes, eviscerated by cats, spit at by fish and the object of whatever it is newts do to show their disdain, I'll discuss only the Bird and the Dog.

Do you know what a Mynah bird is? It is supposedly a feathered creature incapable of thought that can hear, remember and repeat an unlimited amount of words or phrases. . . sort of a winged L.O.!

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makings of a Vice Director. (Here it is again – campaign slogan: "Being a Director's nice – as for me, I'm for VICE!)

My XYL's Mynah, Gus, is not only a dedicated and confirmed, but positively vindictive, anti-ham.

After ten months of listening to a tape repeat, "Hello there!" he remained unflinchingly mute. Yet after only one visit from an old Navy CW crony (strange individual whose limited vocabulary consists mainly of 15 four-letter words which he can interchange indefinitely and still remain intellectually coherent), Gus, that $70 feather-covered fertilizer factory, selected and committed to memory one foul unprintable suggestive phrase which details an action singularly abusive to one's hat. He reserves it for my 'on the air' time.

"How," I once in frustration asked a dim-witted relative, "do you stuff a Mynah bird?" to which he predictably replied, "Dahh . . . head first, I suppose!"

On the other hand, Fred, our French poodle, has developed not only a rather unique and demonstrative method of expressing his feelings towards ham gear, but I firmly suspect that he's somehow managed to enlarge his storage capacity in order to more dramatically emphasize his point.

By golly, if I ever catch that flaky looking pop-eyed pansy in the act, I'm gonna swooosh him with my CO_2 bottle, freezing him in that three-legged position, and auction him off at the next Op-Art festival as a frozen still life entitled, "Dog With Upraised Leg," or "Coldcocked Canine Critic!" (He might make a demonstrative hood ornament for an Edsel.)

Wanting to be perfectly objective, I must admit that there is some justification for society's apprehension. For while the Joe Normals are perfectly content to go from womb to tomb without making a wave, Joe Ham is busy fouling up the newly-arrived dishwasher in an attempt to determine how it works, dangling from the tippy-top of some elm tree with his pockets full of dikes, vice grips, instruction manuals and a hip-holstered walkie-talkie or, in general, doing something that appears unorthodox.

How do you explain that a ham is, first of all, a unique individual whose need to

communicate is but the end result of an insatiable curiosity, boundless imagination and an uninhibited necessity to express himself?

A ham is really a state of mind. Like the man said, "The mind is like a parachute, it functions best when open!"

It is inevitable that with such an unlimited sphere of interests what sometimes starts out as normal and reasonable often results in a fiasco. Society never sees the success, only the fiasco. To them it's moronic – it's the *klutz* factor!

I've often thought that, instead of the diamond decal, hams ought to adopt a more expressive heraldic coat of arms consisting of a sprig of mistletoe embroidered on a flapping coat-tail floating in a sea of Lavoris (for Pucker Power) with a Latin inscription meaning, "It seemed like a good idea at the time!"

Lemme cite two instances which, even though reasonable at the time, eventually turned me into a *klutz*!

Peek-A-Boo

Having a rather high-pitched voice (it's possible I went from infancy to senility without ever having gone through puberty – my voice has never changed and I never had pimples – even an acne transplant didn't take) I have long envied those operators that come on like Gang Busters, sounding like Big John, Captain Marvel and Boom-Boom Bailey. Their deep basso profundo voices thunder in – even on Sideband – like AM Hi-Fi!

I've studied acoustics incessantly, built a triangular room, used a compressor and even fed my voice through an amplifier with the treble retarded and the bass at maximum with the end result that I still sound like a composite of Johnny Weismueller, Tiny Tim and Truman Capote!

In deference to Gus, my normal operating procedure is to use a set of cans with mike attached, leaving my hands free to pursue my secondary avocation of bending Barbie, Ken and Skipper dolls into obscene poses (I have the better ones bronzed and mounted, giving my ham shack the appearance of a cross-sectional view of a house that – if real – would require the services of a Madam!)'

One evening while in QSO with the head of a disgrunted Amateur Radio group called MUSIC (Mad and/or Miserable Until you Shove I.C.) [it was a boot-leg QSO since, as you know, MUSIC isn't allowed on the ham bands . . . a pun? So shoot me!], suddenly my eyes lighted on a newly acquired 30 gallon green plastic trash can. Aha, I thought, remembering some laws of acoustics, the perfect mini-studio!

Completely oblivious to everything, and without a moment's hesitation, I pulled the trash can over my head and shoulders and began happily discussing my new sound when . . . you guessed it . . . a knock sounded on the trash can.

There are many things that a glib-tongued enthusiast can rationally explain away – lipstick on the collar – that you buy Playboy for the articles – that a 2 KW $1,000 amplifier is an absolute necessity . . . but believe me, and I speak from experience, there is no way you can coherently explain to a tired, unimaginative (now jittery and open-mouthed) insurance salesman exactly what you are doing talking to yourself all alone in a weird little room with a huge trash bucket jammed over your head! Yet it seemed like a good idea at the time!

Where Were You When. . .

Not long ago, as you might surmise, I was doing two things at the same time. First, we'd had a new septic tank installed, and in order to remove the old one it was necessary to pump the contents of one into the other. I'd brought a '62 Rambler up close to the operation. The little Briggs and Stratton pump was chugging merrily away so I installed a dc to ac inverter in the Rambler. It appeared to work, so I climbed out and strategically placed myself between the car and the pump. Whoom! The engine caught fire!

Having learned that in situations like this panic is your worst enemy, I calmly went into hysteria and, with that inspired genius that at one time or another has caused me to be struck by lightning, removed a random finger and put a gigantic elm tree stump into sub-orbital ARC, I unhesitatingly reached for the only immediately available source of liquid (it seemed like a good idea at the time!).

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At that precise instant in time that I pointed the outlet hose into the engine compartment, I was made immediately and quite dramatically aware that not only had I 'done it again' but I was making a popular chaos-describing phrase into a 'living legend' and a real life Cecil B. DeMille spectacular!

Startled by the tragicomic results, I dropped the hose, and, in fetal fashion, crouched – alternatively praying for the engine or pump to die, an escape route, or at the very least a poncho or bumbershoot! Luckily I discovered and grabbed an old Huck Finn type straw hat which I inverted over my head for a modicum of protection.

Besides accumulating in the hat and all over my huge frame, the gigantic pinwheel spray whirled up the side of the house, under the eaves, all over my lilac bushes (which, incidentally, have become the most productive, yet strangest smelling, in ten counties). And, as a crowning glory, the spray adhered to one leg of my 75 meter "V" (needless to say, I've received some odd remarks, on and off the air, about my antenna). It seems that my radiated power is directly proportional to the type of QSO. Bull sessions seem to have a marked advantage over normal or net operations.

I caught sight of Fred surreptitiously peering around the corner with an expression on his face that seemed to say, "Haaa haaa haaa, I couldn't have done better myself!" I grabbed the Huck Finn hat and taking as careful aim as I could through that weird rainbow, I let it fly.

Although I missed Fred, the hat passed close by Gus' window, causing him to set up a scalding idiotic laughter-filled chant of, "He did it! – He did it – blankety blank, he did it! He finally did it, sqwuaaak!"

The end result, aside from having to cut the grass in that area almost daily, was that not only am I and the house studiously avoided (even the yellow line in the road is bowed away from our driveway) but we had to sell the car – which wasn't easy!

We were in no position, financially, to trade off the Rambler, but it became an absolute necessity, because even a brass monkey can't drive around in 15-degree-below-zero weather with all the windows open.

We did however manage – 127 cans of aerosol spray later (it was actually 139 cans, but 12 of them went up my sleeve) – with the windows wide open, and on an exceptionally windy day, to unload it. I see it every now and again. They've painted it, but you can recognize it easily enough. Everywhere they park it, a tree grows!

The point, if indeed there is a point, is that as a ham you may be unfairly singled out as an odd-ball, but if it weren't for all you odd-balls, the rest of society would still be thumping dinosaurs on the head with blunt instruments for their evening meal. Be proud of your idiosyncrasies.

...K1YSD

Vernon Fitzpatrick WA8OIK
McLain Park, M203
Hancock MI 49930

TROUBLE SHOOTING FOR THE NOVICE

Sooner or later almost every piece of amateur equipment needs repair. Trouble shooting your equipment can be a very interesting part of your hobby.

The power supply is a good place to learn trouble shooting as the power supply must be working properly before any other part of the equipment can be checked.

The power supply may be an integral part of a piece of equipment or outboard and cable connected. For the type of trouble shooting to be described only the power supply will be considered. It will make little difference if it is integral or not. There will be variations to the typical power supplies in **Fig. 1**. The precautions, notes and sequence will apply to almost any power supply.

An excellent tool for checking for intermittents, broken wires and general probing can be made from a piece of ¼" plastic rod about 8" long. Sharpen one end with a pencil sharpener.

If the power supply is an ac-dc (transformerless) type use an isolation transformer to reduce the risk of serious shock. Any time a power supply is worked on, the filter capacitors should be discharged. Any time the power is turned on then off the capacitors should be discharged. Don't trust your life to a bleeder resistor. Remove any rings, this can save you a badly burned finger. Keep the bench clean and organized. A pencil and note pad are necessary on any repair bench. Keep notes of any wires disconnected and any components removed. The pad is also handy for noting voltages, resistances and etc.

Low voltage diodes can be tested by reading forward and reverse resistance. This test cannot always be used on high voltage diodes as the internal bias voltage of some diodes exceed the test voltage of the ohmeter and the diode will appear open when it is actually ok.

The only test equipment required is a vom and two sets of test leads. One set has insulated alligator clips. The other set has needle point tips. The needle point tips are better than the duller type as the points will pierce any resin flux or other material that could prevent an accurate reading. This is particularly important when working on surplus equipment that has been treated with moisture-fungus proofing.

The more elaborate test equipment will speed and simplify trouble shooting but you must understand the equipment to properly interpret the readings. As an example, an open secondary winding on a transformer can have enough inductance to give nearly a full voltage reading with a vtvm. A vom will load the open winding enough to clearly show it open.

The first step in any trouble shooting should be a good visual inspection.

The following key is designed to help you follow a logical sequence rather than take random tests and hope that you will luck onto the defective part. The key is based on the assumption that a symptom will indicate the failure of certain parts. As an example, if we have a defective power supply and turn it on and the pilot lamp lights it will be a waste of time to check the fuse but we might well check the rectifier tube or diodes. As you follow the key you will note that various symptoms will indicate checks until we have checked every part of the power supply right down to wires, sockets and plugs.

When using the key with a power supply that is not exactly the same as the schematic in Fig. 1, a quick comparison to your schematic will show the steps to follow. If your supply does not have a fuse just pass over the fuse check steps and continue on. If your supply has a three section filter capacitor and two chokes or resistors, make the additional checks when you come to the steps for checking these components in the key. Singular and plural on all components are interchangeable (where the key has diodes, diode will apply and so on). It makes no difference whether the pilot lamp is in the secondary as shown or in the primary circuit. The same steps and checks will apply to a half wave power supply. The key can be used for many low voltage supplies for transistor circuits.

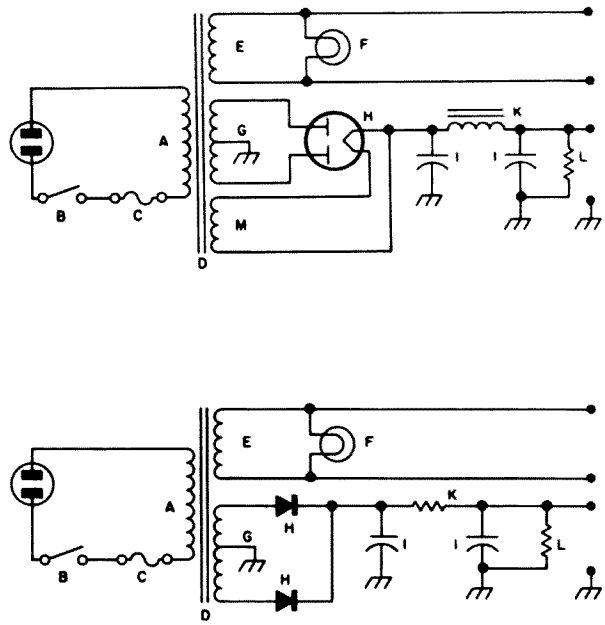


Fig. 1. These are typical power supplies used in Novice gear and were used for making the trouble shooting key. Parts identification: A—Primary winding; B—Power switch; C—Fuse; D—Power transformer; E—Filament winding; F—Pilot lamp; G—Secondary winding; H—Rectifier tube; H—Diode; I—Filter capacitors; K—Choke-coil type; L—Bleeder resistor; M—Rectifier tube winding.

Some of the checks may appear long and cumbersome. The filter capacitor checks are an example. Frankly, it is difficult to check capacitors with a vom. The capacitors are expensive and difficult to replace, so it is worth spending a little more time to be *sure* they are defective. We could reduce steps 15 and 19 to 'Test filter capacitors. Replace if defective.' If you do not have a capacitor tester the key would be of no value to you. Every Novice has, or should have, a vom.

Experienced repairmen use a mental key. This is why the TV repairman asks you, "what does it do?" He wants symptoms so he can use his mental key. As you gain experience in trouble shooting you will develop a mental key. If your key is good enough and generously cross-referenced you will be able to repair the 'tough ones'.

To use the key for trouble shooting determine the primary symptom. If the power supply has more than one symptom you might have to go through the key for each symptom to locate all the defects. The key will indicate the repair for each symptom. The symptom will have a number for a check of a suspected component or components. If the component is defective the key will indicate the repair. If the component is ok the key will indicate the next check to make to locate the defective part.

Key to Power Supply Trouble Shooting

Power supply works – but
Hum is present. Go to 15
Power supply overheats
A. Power supply is overloaded. remove load. If power supply is now ok go to 21
B. Overheating is still present with no load. Go to 20
Power supply does not work – pilot lamp is known to be good Fuse blows. Go to 20
Rectifier tube or diodes are known to be good. Go to 1
Rectifier tube or diodes are not known to be good. If check 2 is ok go to 17
1. The power supply is turned on and the pilot lamp does not light. Go to 3
2. The power supply is turned on the the pilot lamp lights. Go to 10
3. Check outlet to be sure power is available. If no power, check house circuit. Power available. Go to 4

4. Check fuse. Do not depend on visual inspection. Use an ohmeter. If fuse is blown replace. If fuse blows again go to 20. If fuse is ok go to 5

5. Unplug power supply and using alligator clips connect ohmeter to power plug terminals. If ohmeter reads open go to 6. If ohmeter shows continuity go to 10. Be careful here because we may have an intermittent component.

6. Flex power cord at plug and where wire enters chassis. Watch for meter fluctuation indicating intermittent. If cord is intermit, replace it. If circuit is still open go to 7

7. Tap fuse holder. Watch for intermittent. If present, clean or replace fuse holder. If circuit is still open go to 8

8. Wiggle handle or knob on power switch. If intermit. clean or replace switch. If circuit still open go to 9

9. Check each component individually including transformer primary for continuity. Replace any open component.

This completes primary circuit testing. All defects in this circuit should now be repaired.

10. Check transformer filament winding for continuity. If open, replace transformer. If pilot lamp is in primary circuit check transformer primary. If open replace transformer. Be sure to remove any parallel load when checking transformer windings. If ok go to 11

11. Discharge filter capacitors. Go to 12

12. Check all connections for loose or broken wires. Press against wires with plastic probe for check for breaks. Replace any broken wires. If ok go to 13

13. Check any transformer windings not previously checked for continuity. See 10 for procedure. If any windings are open replace the transformer. If ok go to 14

14. Check filter choke or resistor for continuity. If open replace. If ok go to 15

15. A rough check of filter capacitors can be made by using an ohmeter. – to chassis (gnd). + to capacitor terminal (reverse for bias circuits). The ohmeter should show low resistance then slowly increase. If the meter stays on low or high ohms the filter capacitor is probably defective. If defective replace or follow through to 19 for confirming check. If ok go to 16

16. Check the bleeder resistor. It is just a convenient time to do it. Go to 17

This concludes ohmeter trouble shooting. We must now use power on testing to



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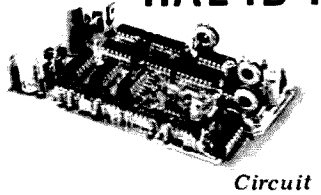
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complete the trouble shooting. Observe all precautions discussed at beginning of article.

17. Check transformer secondary winding at tube plate pins or diode anodes for proper ac voltage. If low replace transformer. If ok go to 18

18. Check cathode of tube or diodes. Low or no dc voltage, replace tube or diodes. Diodes should be checked individually as only one may be defective. If ok go to 19

19. The filter capacitors can be checked under actual operating voltage. Remove all load from the power supply. The bleeder resistor can be left in if you determine the current flowing through it by ohms law. unhook the wire going from the rectifier to the filter components. Use the insulated alligator clips and MA meter. Connect – to filter circuit, + to the rectifier (reverse for bias circuits). Turn the power supply on. for the average power supply the capacitor leakage should not exceed 5-7 mA. If the bleeder resistor has been left in be sure to subtract the current going through it. If the filter circuit uses separate capacitors and the leakage is high check the capacitors individually as only one may be defective. The no load voltage of the power supply will be higher than the operating voltage but this is good for testing the filter capacitors. If there is no leakage through the capacitors and the resistance stayed high in 15 the capacitor is probably open or reduced capacity and should be replaced. The presence of hum confirms this.

This concludes the power-on trouble shooting.

20. Inspect components for evidence of overheating. Use the ohmeter to check for shorts. Inspect tube sockets, cable plugs and sockets for cracks and 'burn paths' where it could have arced over. Refer to 15 when checking filter circuits for shorts.

A faulty transformer will not always show a short to gnd (chassis). Remove all load from the secondary windings. if the transformer still overheats or smokes it is defective.

21. A fault in the equipment is overloading the power supply and causing it to overheat. Repair defective equipment.

This completes the trouble shooting key. If you have followed through the steps carefully the power supply should be repaired. There will be times when you will be in the mood to debate the following statement; when *everything* is ok the equipment *will* work. Happy trouble shooting.

. . . WA8OIK

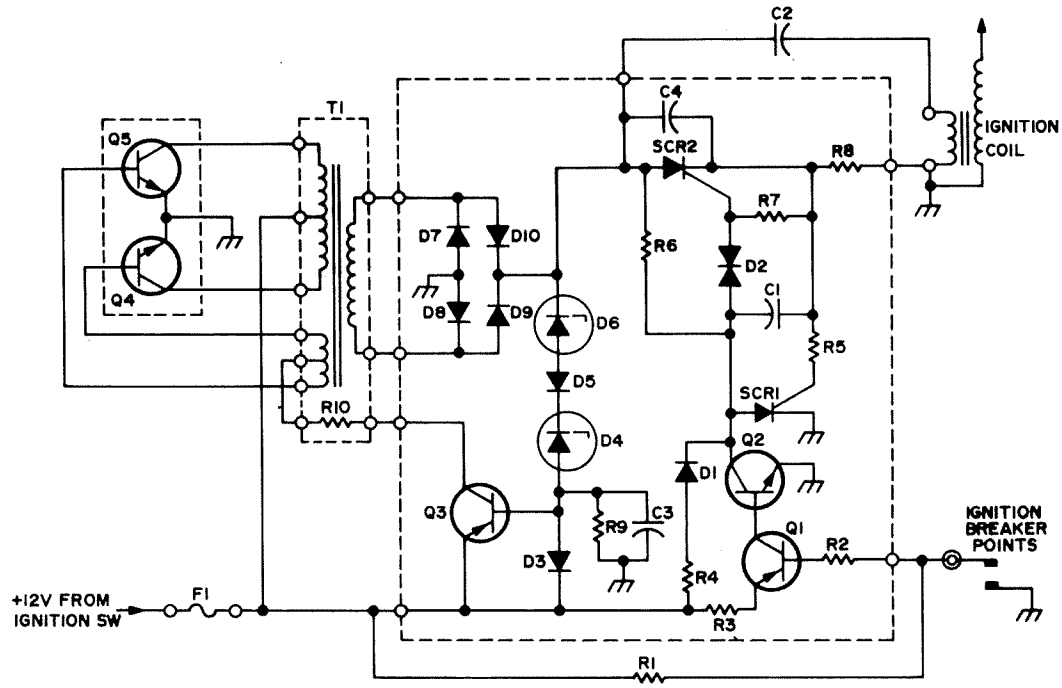
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IMPROVED LOW-COST CD IGNITION



Judging from various construction articles written in recent years, solid-state ignition systems are going through a design improvement stage which bodes well for their final acceptance in the automotive field. Single-transistor, special-coil and multiple-transistor, standard-coil circuits have been around for about a decade, chalking up performance records ranging from good to miserable, with the latter heavily outweighing the former. For example, in my case, a 2N1167A transistor and special 400:1 coil was used for about 3 years with coil failure ending a frustrating series of ignition malfunctions due to point contamination and transistor characteristic change.

A well known automotive parts supplier in Chicago a few years back was vending many brands of transistor ignition systems with glowing praise of its "electronic promise." Today his catalog lists only a couple of high-priced reliable units and it is unlikely that this is due to a saturated market! Information gathered from individual users and garage repairmen point up



Parts List

C1 – .1,100V
C2 – 1.0 μF, 600V oil paper
C3 – .01
C4 – .01, I kV
R1 – 68, 5.0W
R2 – 4.7K
R3 – 2.2K
R4 – 220
R5 – 680
R6 – 150K, 2.W
R7 – 680
R8 – .5 (3 ft #32 E. wire)
R9 – 4.7K
R10 – 180/270 2.W See text
D1 – 1N914
D2 – MPT28
D3 – IN914
D4 – 200.V, 10.W zener
D5 – .75A, 400.V
D6 – 150.V, 10.W zener
D7–D10 – .75A, 1 kV
Q1 – 2N1132
Q2 – 2N697
Q3 – 2N1132
Q4, Q5 – 2N3055
SCR1 – Small 100.V sen. gate like C106F2
SCR2 – 500.V, 20.A
F1 – 4.A
Q4, Q5 heatsink – Birtcher #4AL-6-0-0
Q3 heatsink – Fuse clip chassis 4x6x2 w/bottom cover
T1 – Core = Ferrox cube #K3-005-01-3E
Wire = 55' #26 Formvar, 4' Ω14 Formvar
Ins. tape Epoxy

Fig. 1. Schematic diagram of the improved low-cost CD ignition.

the basic fact that performance has been less dependable than the simple Kettering system. Besides, if it's more costly, why bother? A set of points and plugs every 10,000 miles is not too great a price to pay for dependability.

However, the search for improvement has continued and now a relative newcomer is in the spotlight, CD ignition. In spite of its greater complexity, capacitor discharge ignition offers much in the way of improved all-weather starting and considerable freedom from point problems. In addition, so-called "breakerless ignition" is more easily implemented with a CD circuit and indeed manufactured systems may be purchased; but for now they are too expensive for the average motorist..

This paper details some interesting results of experiments aimed at improved reliability of a CD system over a wide range of temperature, battery voltage, and ignition point resistance. These very important factors have been lightly regarded or ignored altogether by some designers. Circuitry for the unit shown in Fig. 1 has been simplified consistent with optimum performance and borrows some ideas found in two recent reports. [1,2]

Three objectives, listed in the order of their importance, were borne in mind during development and test: dependability, performance, and cost. Concerning the first, worst-case design limits for temperature, battery voltage, and point resistance were set at −40 to +85°C (still-air ambient), 6–16V, and 20 kΩ, respectively. This required silicon devices throughout, operated well below maximum ratings. All circuit elements are soldered in place – no

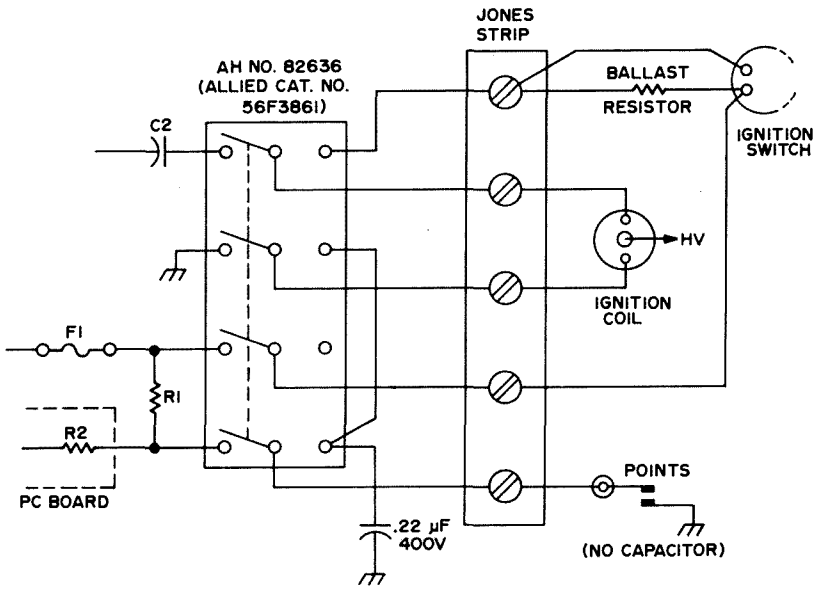


Fig. 2. CD/Normal via 4 PDT switch.

sockets allowed.

To simulate cold weather starting, all parts were cooled to −40°C in a large Dewar flask, point resistance increased by a 22 kΩ resistor and with 6V input, a 1.5 cm spark in air could be obtained, about 18 kV. At the other extreme, full spark energy of about 35 kV was available at 400 pps, 85°C at any voltage between 8 and 16V.

CD ignition requires a source of high voltage dc and this is ordinarily supplied by a dc/dc converter. Much of the cost is right here, in switching transistors and transformer. After experimenting for many weeks with overheated filament transformers pressed into converter service for which they were not designed, great elation was felt in reading the Morris-Morton article with its complete transformer construction plans. A toroid core was quickly obtained and wound to specs. Although lower cost switching transistors were used, performance was exactly as described and a major bottleneck resolved.

Circuit design followed transmitter practice, working from the output stage towards the input. A 1μF capacitor charged to about 350V and discharging into the primary of a regular 12V ignition coil via an SCR was chosen as the starting point. It was soon discovered that inexpensive SCRs were lacking in gate sensitivity and triggering by a UJT was marginal, especially at −40°C. A trigger diode in a standard

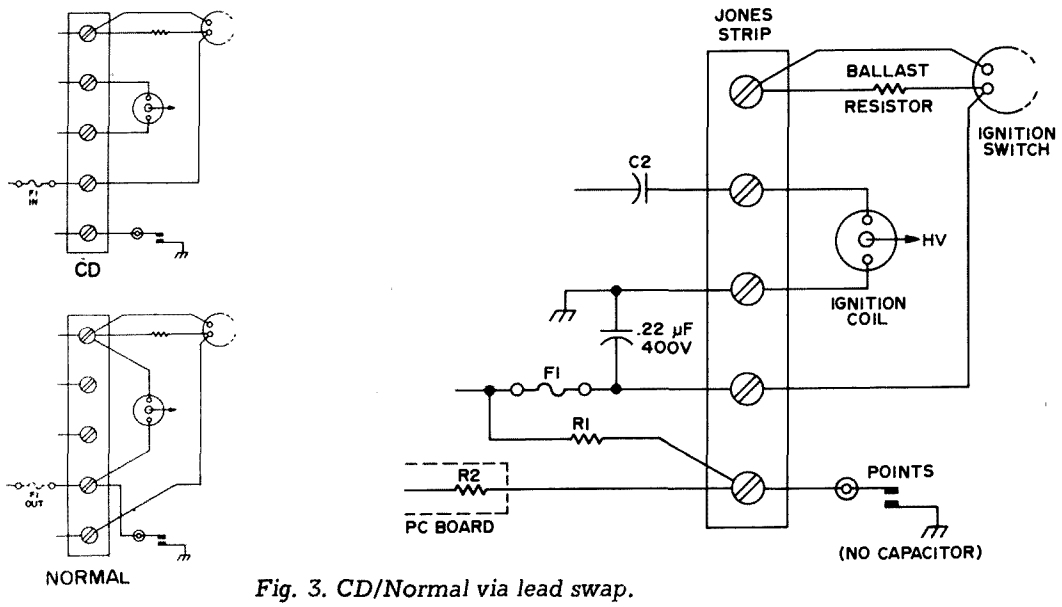


Fig. 3. CD/Normal via lead swap.

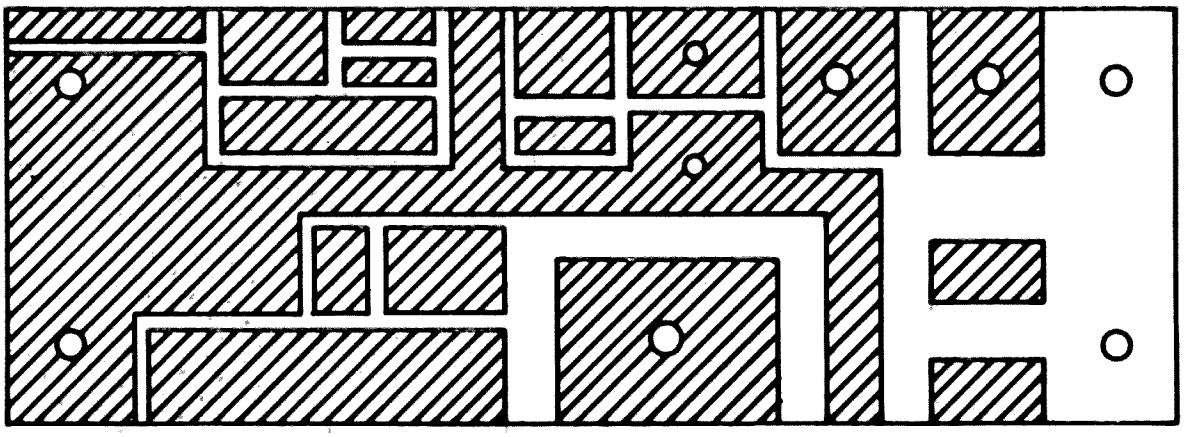


Fig. 4. Actual-size PC layout of board A.

circuit worked fine however, and was incorporated. Its RC time constant takes care of point bounce mentioned in previous papers. No-load B+ of 650V inadvertently applied to a 500V SCR was destructive and after the tears had dried, feedback regulation of the high voltage was added.

An SCR latch connected across the output SCR gate assures only one correctly timed ignition spark for each point opening. Point resistance tolerance and latch reset is controlled by a two-stage saturating switch which has outperformed all other circuits tried. It consists of an NPN switching transistor that can pull the SCR anode down to 0.2V at −40°C (worst case), causing positive reset. Signal inversion, current gain, and dc level shifting is provided by a PNP input transistor. Rate of point opening and closure, ranging from very slow during starting in subzero weather to 400 Hz for a V-8 at 60 mph does not and cannot upset proper operation.

Speaking of breaker points, it seems that oil fumes leaking past the distributor shaft upper bearing, creepage of cam lubricant, ozone inside the cap, and just simple oxidation of tungsten surfaces singly or collectively brings on increasing electrical resistance that can cause malfunction in an electronic system. Without R1, this circuit failed at 920 miles after initial installation, using brand new points running essentially "dry circuit." A single swipe across the points with a book match cover got us going again immediately, but it was a loss of 100% reliability. Current bleed via R1 of fractional ampere has proved to be a reliable solution during 22,000 miles of failure-free driving to date. Apparently a tiny arc at point opening time vaporizes whatever contaminant may be present, preventing buildup. The higher energy level in the high tension circuit requires clean, film-free surfaces on rotor and inner cap which is at it should be anyway.

There are some circuit details that, when properly dealt with, will insure utmost dependability. (1) Q1 must have low emitter-collector leakage when heated to 100°C; (2) SCR 1 should fire with 3 mA or less gate current and stay latched up when very cold, with 6V applied to R4; (3) Q3 should have a beta of at least 40 and be provided with a small heatsink, as it must dissipate 400 mW; (4) Q4 and Q5 must have a moderate-size heatsink as they heat to 100°C when all limits are high; (5) surplus high-power SCRs are inexpensive and a 20A unit will loaf along without heatsinking; (6) D3 and D5 protect Q3 from transient pulses normally present on the B+ line and D3 provides additional safety for SCR 2 by way of brute-force limiting via the zeners if Q3 should fail; (7) power zeners are also an excellent buy—use 'em; (8) procure a quality capacitor for C3—MIL-type oil paper in metal cans often

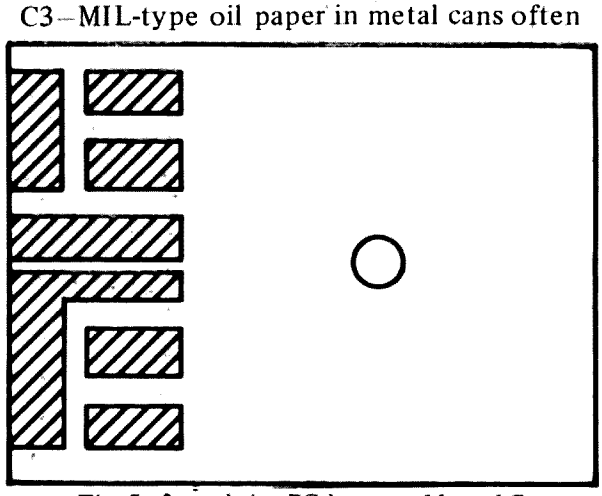


Fig. 5. Actual-size PC layout of board B.

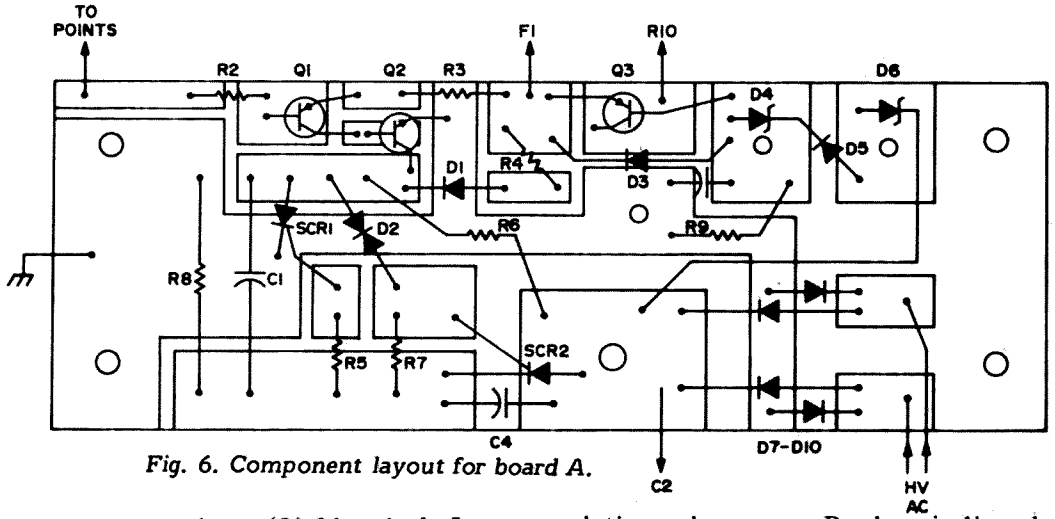


Fig. 6. Component layout for board A.

go for a quarter apiece; (9) Murphy's Law being what it is, switch-back to standard ignition can be provided for either by a four-pole double-throw toggle switch or rearrangement of leads on the Jones strip with quick-disconnect terminals.

Make the PC boards from 1/16 in. single-clad stock. They are designed for face mounting of components, which saves lots of drilling. Wire up the large one, deleting R1 for now. Mount Q4 and Q5 on their heatsink using 6 in. long coded leads. If reference 1 is not available, wind T1 in the following manner. Obtain the specified core and apply an even layer of thin insulating tape. Make a bobbin of strong flat material such as plastic or a tongue depressor and notch the ends to a 6 in. inner spacing. Once around is about a foot, so put on 50 ft of #26 Formvar insulated copper wire. Wind all of this wire on the core in 6 bank-winding sections of 45/50 turns per section and scramble wind where necessary to even the layers. Leave a 1/8 in. gap between start and finish for insulating clearance. Bank winding helps to minimize potential differences along the winding. Cover with a smooth layer of insulting tape. Then put on 20 turns of 14-gage insulated copper wire (4 ft) evenly spaced around the core, with ends opposite the first layer leads. Centertap this winding. Finally put on 10 turns of 26-gage wire, its centertap adjacent to the other, interleaving the small wire between the heavy wire.

Connect the transformer per schematic, then breadboard the entire circuitry for initial testing, using a spare or borrowed ignition coil. Provide a ½ in. sparkgap. Wire a 22 kΩ resistor between R2 and "points" (touch resistor lead to ground). Apply input voltage and watch the sparks fly!

A median value for R10 is about 220Ω. It can be optimized if test equipment is available. The dc/dc converter efficiency is maximized by use of the highest resistance value at R10 causing a 2.8A current drain at +14V when the system is delivering 400 pps into a 1/8 in. sparkgap. Too low a

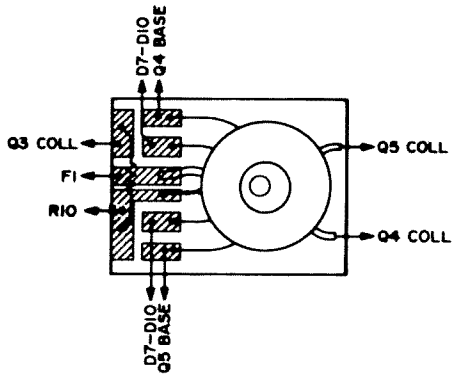
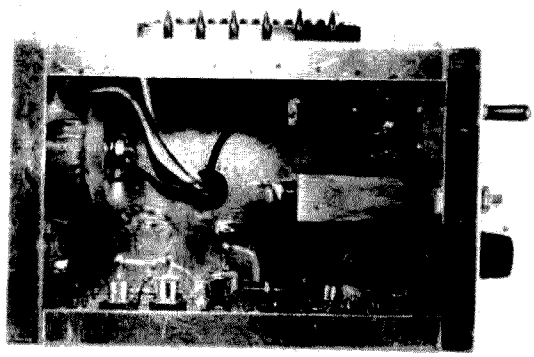


Fig. 7. Layout for board B.



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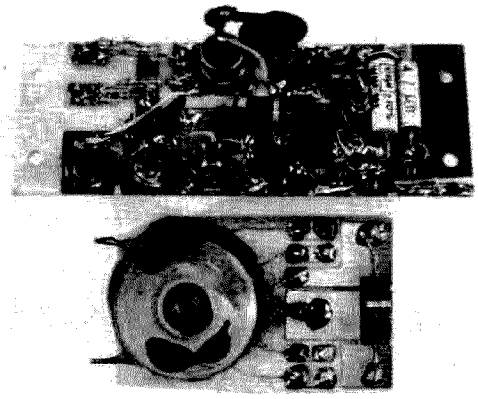
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value will cause excessive heating of Q4, Q5 and a tendency to "squeege"; too high a value will reduce B+ so that high-speed performance is poor. 180–270Ω are ballpark limits.

Mount the transformer on its PC board after completion of tests. Adjust lead dress, then coat generously with insulating epoxy, securing T1 in place at the same time. Leave a center opening for passage of a mounting bolt. After the epoxy has hardened, solder each lead to a PC terminal according to the drawing.



Packaging is the next order of business before actual installation and roadtesting gets under way. The photos show one arrangement using a 4 by 6 by 2 in. chassis with bottom cover. It is a good idea to make the unit drip-proof by sealing all openings with silicone rubber caulking available at most hardware stores. Centralize the large heatsink so that metal straps across the chassis ends can secure the box in place without interference. Don't forget to install R1.

Underhood installation of the completed unit should be such that radiator fan cooling air or incoming air in the case of rear engined vehicles can flow across the heatsink and there is protection from rain, snow, and puddle splashing. Don't overlook inside mounting. Although the air is relatively calm, temperature extremes are less and exposure to weather is avoided. Annoying whine at 1 or 2 kHz of the usual converter is nonexistent in this one which oscillates at 10 kHz. Position so that switch-back to normal is easy, in case of difficulty.

Electrical connection requires tapping into the ignition switch circuit ahead of any ballast resistor, disconnecting the points capacitor and possibly adding leads to tie into the distributor and coil. Check out the connection schematic to see how it's done.

This particular circuit lends itself well to "breakerless" ignition experiments, either optical or magnetic. One breadboard test made use of a variation of blocking oscillator, abrupt start-stop control being effected by a small permanent magnet in proximity to the oscillator toroid core. These ac burst signals drove Q1, eliminating all contact problems.

Acknowledgement is made for the many helpful suggestions and enthusiastic encouragement of my friend and colleague, Mr. Dario Dorigo. His CD in a Corvair is performing in excellent fashion.

. . .W1KNI■

References:
1. Unique CD Ignition System, Morris & Morton, Jan. '69, Electronic World.
2. High Efficiency DC/DC Converter, Levy & Blair, Feb. '69, Electronic World.

William E. Hood W2FEZ
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Albion NY 14411

LIGHTNING

Nikola Tesla watched, elated, as the needle on the ammeter pinned. The room was filled with a roaring, crackling noise and the smell of ozone permeated the air. The scientist walked outside. High atop his laboratory, a metallic globe was alive with a hissing blue cornona. While he watched, fascinated, a bolt of man-made lightning leaped from the globe to the ground. Seconds later, another bolt leaped out a little farther than the first; then another struck farther still. Tesla's machine even seemed to be drawing lightning from the air around it.

Suddenly the noise stopped. Silence closed in like a cloak as the machine went dead. Tesla rushed back into his lab. His machine was intact, but there was no power. The experiment had been terminated by a local power failure. Furiously he telephoned the power station demanding an explanation.

"You're not the only one who wants an explanation," the voice on the other end of the line retorted, "You've just melted the windings in three of our generators. It'll be a cold day in hell before we send any more power out to you!"

It is doubtful that even this brilliant scientist fully realized the awesome magnitude of power involved when he tried to produce lightning, for although it is usually dissipated with comparatively little damage, a single stroke of lightning can contain as much electrical energy as today's average family consumes in a week. A storm of moderate intensity can produce many times the energy of a nuclear bomb.

The actual amount of power in a lightning stroke is the subject of considerable disagreement in the engineering world. Some authorities say that the voltage represented by a lightning stroke is in the neighborhood of thirty million volts. Others claim the voltage can be as high as 900 thousand volts per foot. At that rate, the voltage of a stroke, which can be as much as ten miles long, would reach astronomical magnitudes. The current, on the other hand, is generally agreed by the various authorities to range from four thousand to a quarter million amperes. The duration has been measured at 5 to 50 microseconds.

The electrical charges that produce lightning are thought to be produced by friction between rapidly moving raindrops and the surrounding air. Thunderheads are known to contain vertically moving air columns which reach velocities in excess of 100 miles per hour. Raindrops and ice particles, moved about by these currents, develop electrical charges. The vertical movement accumulates these charges much in the same manner as the vertically moving belt in a Van de Graaff generator.

The turbulence within a thunderhead develops a strong negative charge in that region of the cloud where the temperature is between 0° and 32°F. A positively charged zone develops in the upper portion of the cloud, and the lower portion of the cloud contains both positively and negatively charged zones. From this it can be easily understood why 65% of all the discharges are within a cloud or between clouds.

Lightning strokes, either within or between clouds, or from a cloud to the ground, occur when the voltage between charges of opposite polarity exceeds the breakdown potential of the intervening air gap. This breakdown is of a different nature than the breakdown of a small air gap. There appears

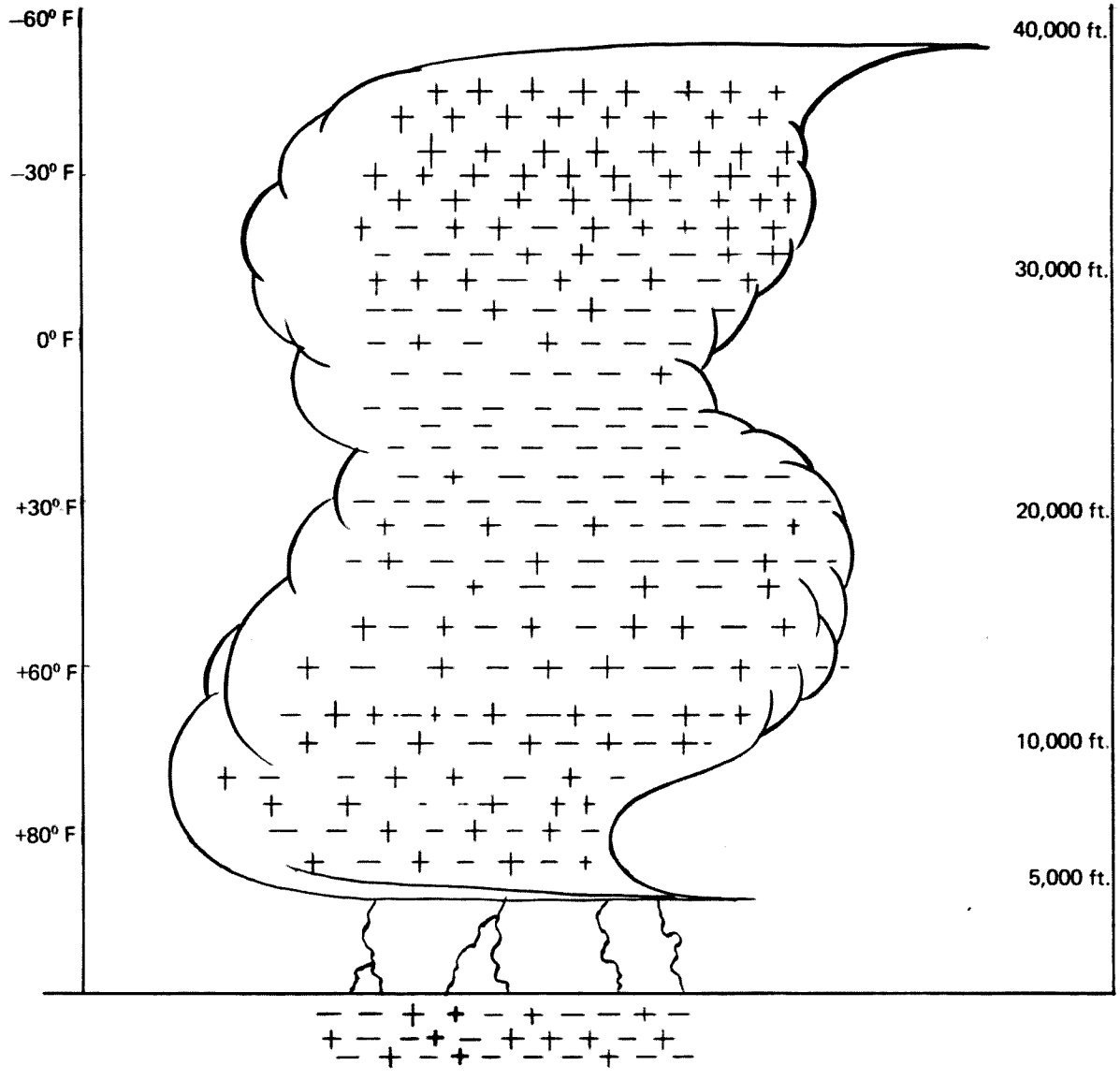


Fig. 1 . A thunderhead is a towering cylindrical cloud, often extending as high as 40,000 feet. Negative charges generally accumulate in the region of 30 to 0°F. Positive charges accumulate in the upper portion. Both positive and negative charges occur in the lower portion. The characteristic anvil top is caused by upper atmospheric winds.

to exist a potential, the exact magnitude of which is yet to be determined, beyond which air breaks down a little at a time.

As charges accumulate in the lower portion of a thunderhead, equal and opposite charges are produced by electrostatic attraction in the ground and all grounded objects below. As the potential passes the breakdown level, "leader strokes" begin probing their way toward the opposite charge. Usually the leaders start from the cloud, but sometimes from the ground. Advancing 50 to 60 yards at a time, and pausing about 100 microseconds between steps, the leader works its way toward the opposite charge. Then current flows, a small stroke dissipating as much as five kilowatt hours, and a large stroke, many times more.

A lightning discharge, like any electric current, follows the path of least resistance which is almost never a straight line. The potential gradient from a cloud to the ground is constantly being distorted by the turbulence of the atmosphere On the ground, moisture, temperature, and the varying quality of the ground itself play important roles in determining the path of a stroke. With all these variables, lightning has been observed to do some pretty strange things. A neighbor of mine had her house struck. The bolt travelled down a drainpipe, followed the electrical wiring across the

cellar into the back shed, then jumped to a sink, scaring the tar out of her son who was repairing his bicycle in the shed.

Some of the phenomena manifested by lightning are so weird that it becomes hard to separate fact from fiction. For instance, ball lightning was long thought to be an old wives' tale. Too many credible observations by competent personnel have been reported, however, to pass it off as a myth. Present theories consider the phenomenon to consist of a small, heavily charged mass of ionized air that becomes separated from the path of a stroke and then drifts along with natural air currents until it either dissipates or finds a ground path where it discharges, sometimes with explosive violence. Sheet lightning is thought by some to be merely reflections of lightning discharges in a faraway cloud. Others think it is the instantaneous discharge of a large area of atmosphere, spreading the energy that would otherwise be discharged in a stroke over a wide area – a sort of high-speed Aurora Borealis.

People have gone to great lengths over the years to protect themselves from lightning, ranging from charms and prayers to more scientifically sound methods. When Mr. Franklin invented the lightning rod, all sorts of applications were tried. An early drawing depicts an umbrella with a lightning rod on top and a conductor trailing off along the ground. Good thinking, but a very dangerous device. Lightning rods today are confined to the tops of buildings.

Modern-day lightning rods are generally pointed, not so much to make them more likely to be hit as to prevent the buildup of charges that would lead to a stroke. It is generally known among those who work with high potentials that a point encourages corona discharge. Working on that principle, the point on a lightning rod constantly bleeds off accumulating charges thus pre venting their building up to a dangerous level.

In the communications field, lightning protection varies depending not only on the nature of service but on the geographical location as well. This is because the frequency and severity of thunderstorms varies throughout the continent. Equipment that is protected sufficiently on the west coast would go up like a Roman candle in central Kansas or on the Florida peninsula. In the latter two areas, electricians do as much business repairing lightning damage as they do putting in new installations. The Great Lakes region has 50% more thunderstorm activity than the New England coast. By contrast, southern Alaska has perhaps only

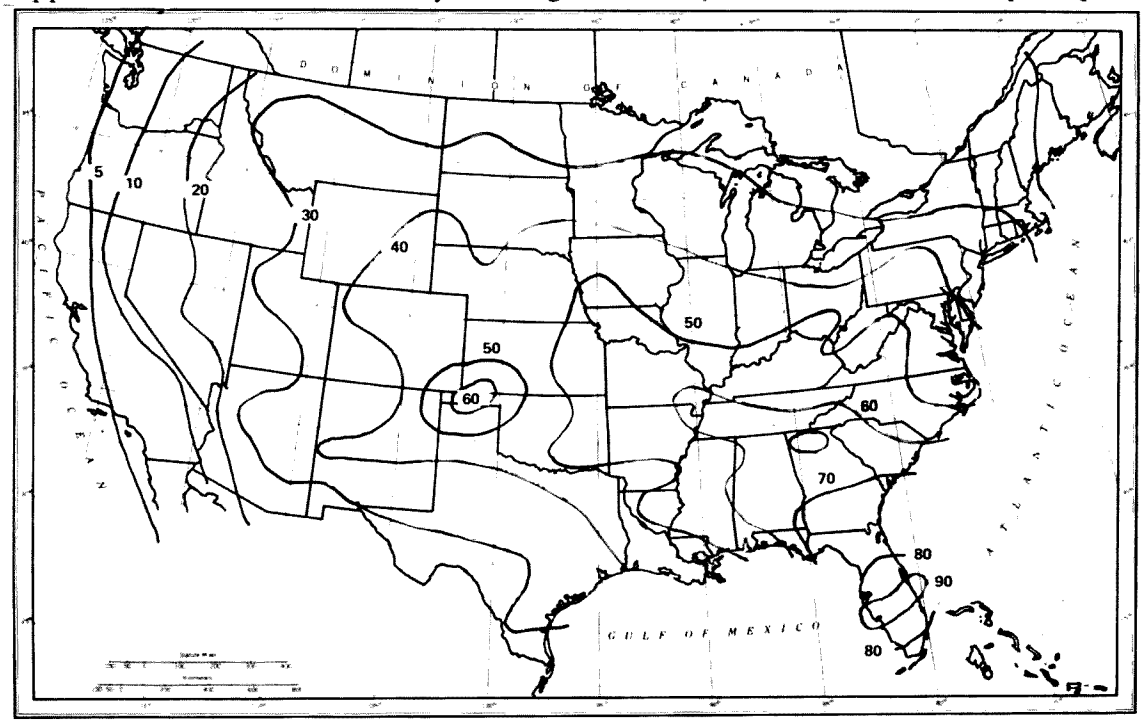


Fig. 2. Average number of days of thunderstorm activity per year in continental United States.

one day of thunderstorm activity in two years.

Protection requirements further depend on the amount of exposed wire and on the conductivity of the ground. It is much easier to protect equipment situated in a salt water marsh than in dry, sandy soil.

It should be realized that virtually nothing can protect an antenna or signal wire from a direct stroke. Considering the tremendous magnitude of current involved, it is easy to understand that even a very heavy ground conductor might be vaporized. However, proper protective equipment pays for itself, protecting equipment against a little-publicized phenomenom known as a ground surge.

In order to better understand a ground surge, picture for the moment the plates of a charged capacitor. When a conductor is connected between the plates to discharge the capacitor, current flows through the conductor from plate to plate, and *from all points on the individual plates to the conductor*. Comparing an electric charge in a cloud and the ground below it to the places of a capacitor, and imagining the path of a lightning discharge as the shorting conductor, it is easy to see that each time lightning strikes, current flows through the path of the stroke from the ground to the cloud; current also flows through the ground from all surrounding points to the point where lightning strikes.

If lightning struck a point several hundred yards from an antenna tower, current would flow down out of the tower and through the ground to the point where the stroke occurred. The magnitude of these surges can be as high as ten percent of the current in the lightning stoke itself – as much as several thousand amperes. If the equipment in your shack were grounded at more than one point, a ground surge might find an easier path through the interconnecting wires than through the ground. In that case, goodbye equipment. This one hideous thought clearly illustrates the reason for one and *only* one ground point in a well-protected shack.

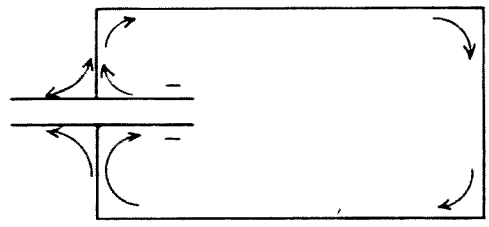


Fig. 3A. When a capacitor is discharged, current not only flows through the shorting path but through all parts of the plates as well.

Where remote control lines or other types of signal wires run long distances above ground, ground surges from lightning are a major problem. The railroads, using unshielded signal lines running for miles at a stretch, often go to great extremes to protect their delicate and costly signal equipment. Each line has a heavy-duty lightning arrester connected to ground at the point where it enters a wayside housing. Electronic devices such as carrier-current transmitters and receivers are further protected by high-speed gas discharge tubes on each terminal.

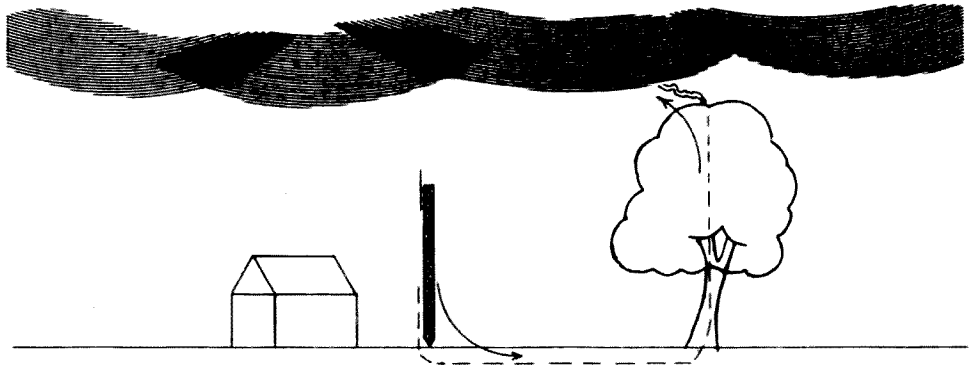


Fig. 3B. Picturing the sky as a plate of a charged capacitor and the ground as the opposite plate, a lightning stroke causes current surges to flow down out of nearby grounded objects, through the ground, and along the path of the stroke to the sky.

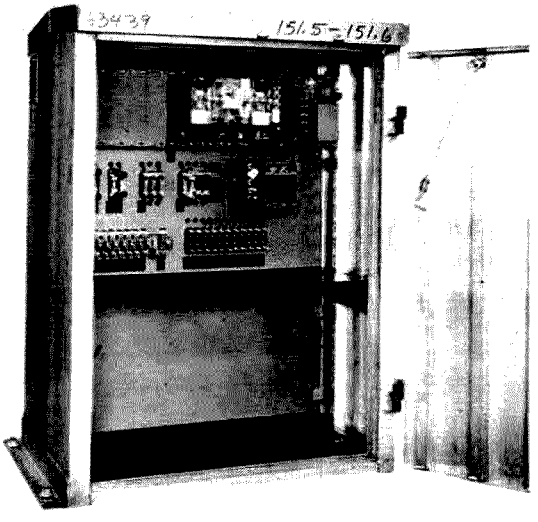
Every ground terminal within the housing, as well as a connection to the housing itself, is brought to one common ground point called the "prime ground terminal" which is connected to earth ground through the lowest resistance path possible. Railway signalmen have told of standing inside a wayside housing during a storm and seeing the arresters constantly flashing like a small fireworks display. A severe surge will cause a railroad arrester to blow off its glass covering with a report like a gunshot.

Although telephone lines often run long distances above ground, many types of cable are shielded, and surges occur mainly in the shield where they harmlessly bleed off to ground.

In the home, the telephone line is connected to ground through two carbon fuses of carefully calculated resistance. One carbon fuse connects each side of the line to ground, thereby holding each side of the line at an equal potential above ground, thus zero volts with respect to one another so far as alien power surges are concerned.

At the exchange each incoming conductor is connected to ground through a carbon fuse and all the ground connections made through one common terminal.

Commercial broadcasting stations, as a general rule, use relatively crude lightning protection methods. A piece of heavy bar



A typical wayside case for railway signal equipment. The lightning arresters are in the bottom row at the left of the case. (Photo courtesy General Railway Signal Company)

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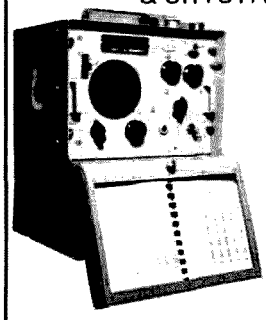
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Lightning arrester at the base of a commercial broadcasting tower (WADD, Brockport NY).

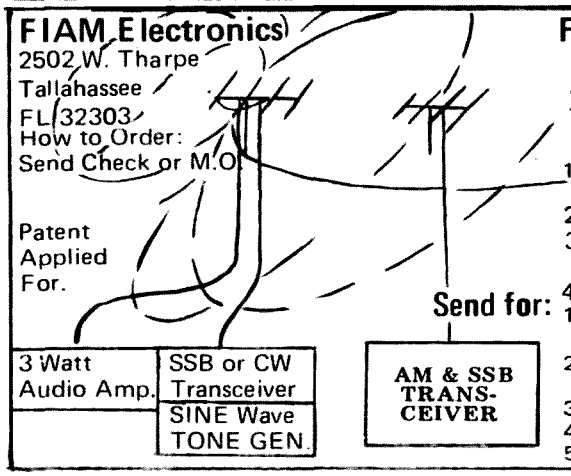
stock with a ball shape on the end is connected to the base of the tower and positioned in close proximity to a similar piece connected to the ground system. This is generally sufficient, since the transmitting equipment is quite rugged and of low impedance. About the worst that generally happens is that a breaker opens, putting the station off the air until an engineer resets it. There have been occasional colorful results however. The engineer of one local station told of a strike following the transmission line into the building and making a spectacular display as it zipped around the baseboards, finally grounding out via several electric outlets.

Lightning protection, then, depends upon many variables. Factors such as the amount of thunderstorm activity, the amount of exposed line, the equipment to be protected, etc. To even begin to describe the various techniques and the reasons for them would take a book of considerable size. Perhaps the main determining factors are the possible consequences of loss, and the economic status of the owner of the protected equipment.

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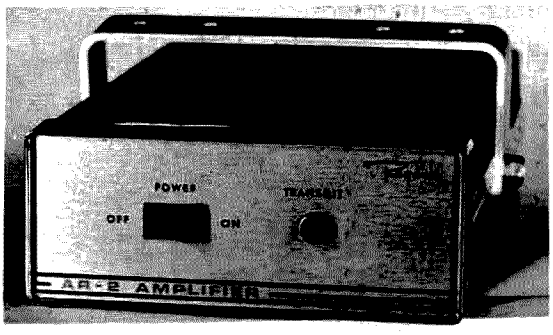
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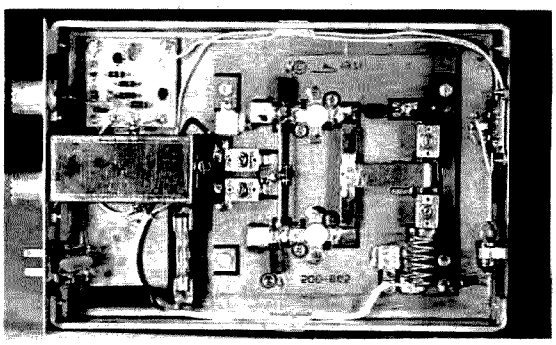
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Ed Webb W4FQM/1
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73 REVIEWS THE REGENCY AR-2 2-METER FM AMPLIFIER





If the growing number of manufacturers of power amplifiers for 2 meters, only two (as of this writing) are very conservatively rated on the input and output ratings of their amplifiers. One is on the west coast and the other is Regency in Indianapolis, Indiana. Regency again has followed the tradition started in the HR-2/2A transceivers of being very conservative on power ratings. They rated the HR-2 at 10 watts. It put out at least 12. They rated the HR-2A at 15 watts. It puts out almost 18.

The new AR-2 is made in a matching size and style to be a companion to the HR-2/2A transceiver. When you pick it up, you would think it was made of lead. It's hefty, yes, but not from lead: copper is the name of the heat sink material that is used. The AR-2 is literally an amplifier built on, or almost in, a huge copper heat sink. Does it get hot while transmitting? Not with PTT operation. With 10 watts input, Regency rates the amplifier at 38 watts output – ours put out 44. With 15 watts input, the AR-2 put out 58 watts, and with 17 watts input to it, out came a full 67 watts. That kind of power output coupled to your 3 dB gain antenna will let you talk to the machine on the mountain just about as far as you can hear it. And would you believe that at almost 60 watts output (key down for an hour) this AR-2 barely gets above room temperature – that big heat sink really does its job. Even the collector output tank circuit is constructed of heavy silver-plated copper to better withstand the large rf circulating currents that are found in solid state amplifiers at these frequencies and power levels. The AR-2 uses 2 transistors in a Class C push-pull configuration. The transistors used are of the balanced emitter type with the new wide leads to provide low inductance lead runs. The AR-2 amplifier runs between 60 to 70% overall efficiency.

Installing the AR-2 is a oreeze. Just connect 12V to it and plug in your antenna to the amplifier. Placing a short coax jumper between the transceiver and the amplifier completes the job. To tune the amplifier input up (to compensate for the input feedline lengths) it's best to have a Bird model 43 Thruline® or Model 4352 Ham-mate® watt meter. This is placed between the antenna lead and the AR-2. With the amplifier out of its case, key the transceiver and tune everything for maximum rf output. The amplifier switches itself in automatically when it senses watt or

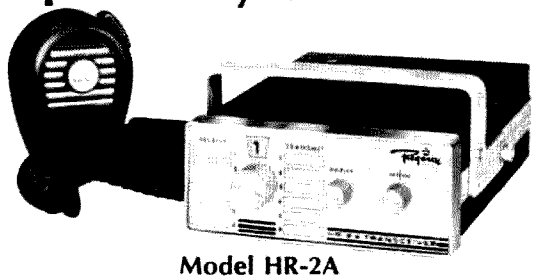
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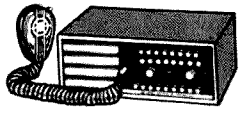
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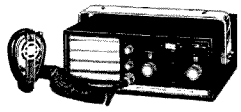


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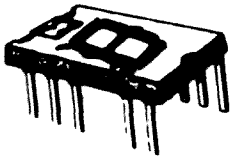


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more at its input. If you want to run barefoot for short, direct hauls, just turn the amplifier power switch to the off position. When the amplifier power switch is in the on position, a front panel red light comes on each time the amplifier is keyed.

Maybe quadrupling your output power won't quite double your range, but with the additional power your transmit range doesn't run out before your receive range does. All those marginal areas where you were noisy into the repeater disappear and now you are full quieting. If you are out in the boondocks or hilly areas like southern New Hampshire, that extra power really does make a difference.

For more information on the AR-2 write to *Regency Electronics, Inc., 7900 Pendleton Pike, Indianapolis, Indiana 46226.* The AR-2 amplifier is priced at only $129. When you figure it out, that's only two bucks a watt output and that is cheap. Regency again has turned out a very nice unit at a modest price.

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AUSTRALIA	14	14	14	7A	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	14	7A	7	7	7A	14	14	14	21	21
ENGLAND	14	14	7A	7	7	7	7	7A	14	14	14	14
HAWAII	14	14	14	14	7	7	7	7	14	14	14	14
INDIA	14	7A	7B	7B	7B	7B	7B	7A	14	14	14	14
JAPAN	14	14	14	7A	7	7	7	7	7	7A	14	14
MEXICO	14	14	7	7	7	7	7	7	7	7A	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7	7	7	7	14	14
PUERTO RICO	14	14	14	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7B	7	7	7	7B	7B	14	14	14	14	7B	7B
U. S. S. R.	7A	7	7	7	7	7	7	7	14	14	14	7A

WESTERN UNITED STATES TO:

ALASKA	14	14	14	14	7	7	7	7	7	7	7	14
ARGENTINA	14A	14	14	14	7	7	7	14	14	14	14A	14A
AUSTRALIA	21	21	21	14	14	7	7	7	7	7	14	14
CANAL ZONE	14A	14	14	7A	7	7	7	14	14	14	14	14A
ENGLAND	14	14	7A	7	7	7	7	7A	14	14	14	14
HAWAII	14A	21	21	14	14	14	7	7	14	14	14	14
INDIA	14	14	14	7A	7B	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	14	14	7	7	7	7	14	14	14
MEXICO	14	14	7A	7	7	7	7	7A	7A	14	14	14
PHILIPPINES	14	14	14	14	14	7B	7	7	7	7A	14	14
PUERTO RICO	14	14	14	7	7	7	7	7A	14	14	14	14
SOUTH AFRICA	7B	7	7	7	7B	7B	7B	14	14	14	7B	7B
U. S. S. R.	7A	7	7	7	7	7	7	7A	14	14	7A	7A
EAST COAST	14	14	7A	7	7	7	7	7A	14	14	14	14

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

73 magazine for radio amateurs

$1.00
July 1972
26009



FLASH! Europe organizes FM with 600 kHz split (details on page 65)



COLOR SLOW SCAN IS HERE!

These pictures were sent by slow scan television.

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Tone Decoder & COR Op Amps

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MOSFET Converters

VHF Power Amplifier

Flying Spot SSTV Scanner

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for radio amateurs
#142 JULY 1972

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73 Magazine is published monthly by 73, Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas. $7 per year elsewhere. Two years $11 in U.S. and $12 overseas. Three years $15, and $16 overseas. Second class postage paid at Peterborough NH and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A. *Entire contents copyright 1972 by 73 Inc., Peterborough NH 03458.* *Phone: 603-924-3873.* *Don't forget to join Lin and Wayne for the European trip in September (page 60). Make note of the proposed DXpedition to Bajo Nuevo (page 112). Will we see you at Expo in July (page 70)? Will you forget to send in the readers service request (page 128)? And wait until you see the coming Rig of the Month contest starting soon in 73! Heh! Articles needed: IC construction projects, SSTV, RTTY, FM, etc. One last message for this month: 220 MHz, use it or lose it.*



EDITORIAL BY WAYNE GREEN

Ham Jamming

The service nets on 40m have been having troubles with jamming . . . catcalls . . . music . . . the works. Hopefully, all involved will recognize there is much to be said on both sides of this controversy, although the situation may look black to one side and white to the other.

The net ops feel they are spending a lot of their time and money providing a valuable public service and that this should not only be appreciated by other amateurs, but they should get some cooperation, to boot. The nets are, in fact, providing valuable services in many instances and, if all amateurs would cooperate, could be of tremendous value as a public service and as a proof of the value of amateur radio.

On the other side are ops who are indignant that any group has the audacity to "own" a frequency. The frequencies are free and open to anyone and they get madder than hell when a net opens up and demands they move off the net "frequency." Then again, there are also those ops who feel that anything organized should be destroyed. If anyone is doing good or being helpful, they should be stopped. In the past these people have broken the noses off statues, burnt books, shredded paintings and smashed babies in front of their mothers . . . they are still at work, even in the hambands, making life miserable for as many people as possible.

What is the answer? Or better, what are some answers? May I suggest some possible avenues for the service nets. High on the list I would put PR. PR on the air . . . courtesy above and beyond the bounds of reason. PR in the media . . . see that the editors of ham magazines and club bulletins get info on services rendered by the nets. As an editor I can affirm that this PR has been sadly absent in the past. With only a little effort and organization any or all of the nets could have had considerable coverage in 73 . . . and probably the other magazines as well . . . perhaps even with monthly columns. PR is the name of the game.

The recent appeal to the chairman of the FCC for help in fighting the jamming of one of the nets did not seem to fall on receptive ears within the FCC . . . and seemed ill advised to me. One of the basic benefits of the amateur service has been our boasted ability to be self-policing . . . so when we run into a problem we make a big stink and put the pressure on the head of the FCC for help. Nuts.

Is it really impossible for us to be self-policing? Must we turn to the FCC to police our bands and solve our problems .,. . recognizing that there is more than a little possibility that our problems are to some degree self-generated? Are the net members really impotent to help themselves? Have they no possible way to organize a system for locating jammers and quieting them? I think all of us recognize that this is ridiculous on the face of it.

If we find that our nets are being jammed we have to do something about it. The techniques for locating a jamming station are not all that difficult for us. Direction finding is simple. Not only is it simple, it is fun. Once the offending amateurs have been located there are several ways of handling the situation. I do not think that brute force should be called for except as a last resort . . . cutting of feedlines, pins in coax, bloody noses should be avoided.

There is no reason why illegal acts should be necessary to stop jamming. The great percentage of jammers will stop their nonsense once they have been uncovered. The few remaining bad guys should listen to reason if visited by a committee.

Isn't that better . . . and more satisfying . . . than asking the FCC field engineers to spend the incredible amounts of time it takes them to chase down our jammers? Let's do it ourselves.

Repeating Non-Amateur Stations

The regs are clear on this. . .it is illegal. Yes, I know that some of the two meter repeaters are set up with tone coding which connects them to the time signals from CHU. I don't see the harm in this. . .and I certainly appreciate the utility of it. I spend a lot of my time within range of a two meter transceiver and a lot of it out of range of a short wave receiver.

By now everyone must be familiar with the time signals from CHU. . .on 3333 and 7335 kHz complete with ticks every second and voice announcements every minute.

Another popular public service that is being toned on by some repeater groups is the Weather Bureau broadcasts on 162.40 or 162.55 MHz, depending on where you are located. There are over 60 of these stations around the country and they play tapes of the weather report continuously. . .and most of them update it every half hour or so.

Perhaps we should give some thought to proposing an official change of the regulations to permit short rebroadcasts of public services such as these.

New 73 Staffer

Keith Lamonica W7DXX has joined the 73 staff in the position of Managing Editor. Keith has been quite active in FM, having set up repeaters recently in Oregon and Tennessee. He is also quite interested in DXing and will be working hard to organize some 73 DXpeditions. Say, would it be possible to have a "DXpedition of the Month?" Let's see, Bajo Nuevo in November – maybe Serrana Bank in December – Cayman Islands in January – Grenada in February – and on around the rarer Caribbean islands. Hmmm?

Keith is hopelessly addicted to amateur radio. In the short while he has been with 73 he has gotten one repeater on the air and is almost up to DXCC from Peterborough. He's got several more repeaters in the works, together with a lot of interesting repeater functions, so the amateurs in northern New England will have some advantages over those elsewhere, being able to down link.

Why the FCC Hassles Hams

A recent rash of harassments of hams by the Michigan FCC Engineer in Charge, who seemed to have nothing better to do with his government financed time than to demand log books from FMers, made me wonder why he wasn't devoting some of his time to trying to clean up the CB problem which is really miserable in his particular area.

A letter from an amateur who works in broadcasting and who has asked not to be identified explains the situation. He talked with a pair of FCC field engineers and they said that they could care less what happens on 2m FM. . .that if anything illegal was going on they depended upon amateurs to take care of it and, at worst, if reported to the FCC, they would look into it. They also do not check CB. They do check the broadcast stations in great detail, running audio proof of performance; they checked

wo-way commercial users for fre-uency and proper operation. But ney just don't check the CB band ecause if they do catch a violator it ist means more work for them. With ie broadcast and business band they re dealing with intelligent and respec-ible people when they issue a cita-on. With CB they are dealing, more ften than not, with idiots. To make ieir job easier they just don't mess ith CBers.

This makes sense, even if it is bviously unfair. Perhaps the FCC eeds a staff of field engineers just to heck up on CBers?

tandard Repeater

Standard Communications has been orking hard to firm up the design on repeater package for a complete two ieter repeater station. In early May iey announced that production had arted on the first run of the units id that the first deliveries were heduled for early July, parts sup-liers willing. The basic units are the tandard model 803 commercial VHF ansceiver boards and the transmitter ins ten watts output. There is a mike ck for a regular Standard micro-hone and a speaker jack for an 8Ω peaker.

The whole package will sell for 595! At that price the number of vo meter repeaters may start zoom-g. That is mighty attractive for a mpletely solid state unit. Many of ie Progress Line repeaters may iange to solid state – it does hold omise of needing a lot less main-nance. It is a bore to get to the top your mountain through six feet of ow to put in a new pair of 6146's hen the old ones go soft.

Will the new repeaters sell? Well, ie day they were announced by andard there were at least three rush ders placed.

ew FM Transmitters

A letter arrived the other day from ternational Signal – the same com-any that makes the fine Clegg equip-ent. It seems they were considering aking some little transmitters avail-ble to the amateur market and won-ered what the reaction to them ould be. The reaction of the others ho received the mailing must have een about like mine . . . I sent in a eck immediately for a bunch of em.

The little rigs arrived in due course d they are fascinating. They are mplete with crystal and micro-hone. All you have to do is connect to an 8-volt battery and antenna id you are on two meter FM – or six ters – or even ten meters. There three different models.

The transmitters are quite well built. They use an 8 MHz crystal oscillator, run the rf through two triplers and a doubler, a buffer and a power amplifier – with an output of 0.1 watt. The mike is a small flat job with high impedance output and feeds into an amplifier, limiter and Darlington amplifier to the phase modulator.

The whole rig is 2½ x 3 x 1 in. and is built on excellent PC board. With that small size you could easily install this in many of the receivers to make a transceiver . . . in a hat for conventions . . . in a little tiny repeater package which would make it possible to have a repeater in your car . . . etc. The mind boggles.

The two meter transmitters will be selling for about $33! Line forms to the right . . . of me.

Equipment for 220 MHz

The Tempo 220 transceiver is scheduled for deliveries starting in July. This $220 AM-FM transceiver should be exceedingly popular. A recent poll in the midwest showed that about 80% of the active two meter group are planning on going on 220 as soon as equipment is generally available.



The Clegg 21 is scheduled to be available about the same time. This unit has some very interesting features, such as using one crystal for both transmit and receive. It will be priced under $300 according to present plans.

The Drake 220 unit will hopefully be arriving from Japan in reasonable quantities this summer and help a lot more fellows get on the air. The price is not firm on this one.

Surplus fans may be interested in the Comco 278 transmitter-receiver on sale by Fair Radio for $40. This is probably an AM job, but certainly can be converted easily for the new FM repeater service. It is tubes, and runs from 6, 12 or 24 volts. It looks like fun. It might be made into a low cost repeater.

Tell Our Advertisers You Saw It in 73

Unused Citizens' Band?

The Electronic Industries Association proposal for taking the amateur 220 band and turning it into a new citizens band is even more curious when you look into the use that has been made of the 460 MHz citizens band. Here the rules are quite similar to those proposed for the desired 220 band, yet activity is negligible in this band. Most of the very few users of the 460 band seem to be businesses which could easily be moved to business bands.

A chap I know has a repeater set up in the 460 band, licensed by his wife. He has the channel virtually to himself, even though he lives in a major city. He says there are a couple of other licensees for the channels he is using, but only one has any activity at all – a police department at a local university.

Perhaps interested amateurs should bring this situation to the attention of the EIA and some of the congressmen that are getting to pressure the FCC to shove through the 220 band steal from amateur radio.

Looking for Work?

If you would rather work for a ham magazine than anything else, you might think about the possibilities of coming to New Hampshire and working for 73. We are growing and expanding and are looking for licensed amateurs to fill several positions. We have a spot opening as an advertising assistant. This would pay on the order of $75 a week or so. We can use some help in the art department with laying out pages and doing finishing paste-up. This starts about the same rate. A good typist for setting our type on the IBM Composer would be worth a bit more as a starter.

The pay is not great, to be sure, but think of the fringe benefits – the gear we get to play with here – the repeaters we can set up – extra good deals on personal equipment – even the possibility of getting to go on a trip now and then.

If you are interested please drop us a line with your resume and tell us about your ham background.

. . .Wayne

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Atlanta GA 30305

Please include IRC and SASE. DX ops, two IRC and addressed envelope. Gorgeous color QSL card forthcoming. Expensive. Also fantastic certificate in the works.

A MODERN VHF FREQUENCY COUNTER

Peter A. Stark K2OAW
196 Forest Drive
Mt. Kisco NY 10549

Part 2 of 3 parts

Two months ago we started describing our frequency counter design, showed how to use it, and gave a complete parts list. This month we will provide the complete logic and schematic diagrams, and describe how it works, and next month we will have the printed circuit board layout, parts layout drawings, and construction and operation information.

Figures 3 through 18 show the diagrams of the various parts of the counter. To see how these parts fit together, refer back to Fig. 2, the block diagram, in last month's article.

0–20 MHz Input Circuit (Fig. 3)

This circuit is one of the most tricky circuits in the counter, since it must convert a variety of input signals, large and small, simple and complex, into digital pulse signals of just the right voltage and speed to operate the counter. This job is considerably simplified by a Schmitt trigger IC, an SN7413N, designed just to interface TTL digital logic to the outside world.

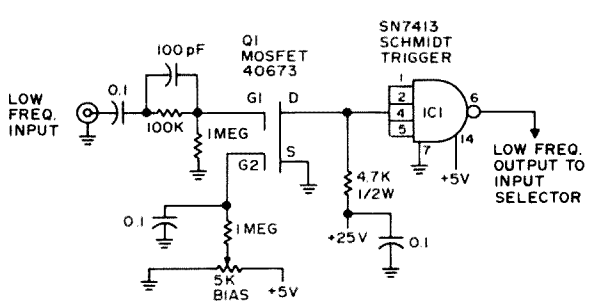


Fig. 3. 0–20 MHz (low frequency) input circuit.

The low frequency input circuit starts off with Q1, a 40673 RCA dual-gate-protected MOSFET transistor which provides high input impedance and a useful amount of gain at a very low price. The input signal from the HI-LO input switch is applied to Gate G1 through a 100K current limiting resistor. Because of the diode-protected gates, the 100K resistor allows inputs up to 50V without damage to the FET.

The 5K bias potentiometer varies the bias voltage to gate G2 to allow the Schmitt trigger, IC1, to operate in the middle of its range. The pot should be adjusted so the voltage on the FET drain is about +1.3V with no signal.

The 0.1 μF dc blocking capacitor reduces response below about 20 Hz. For operation below this frequency the capacitor could be bypassed, but it performs a valuable function of preventing external dc voltages from changing the bias on Q1.

VHF Pre-scaler (Fig. 4)

The VHF pre-scaler accepts input signals from the low rf range up through about 200 MHz – depending on the IC's you get – and divides the input frequency by 10. This is done by two special-purpose – and expensive – IC's.

IC2 is a high-frequency amplifier which allows the use of quite low voltages. It is not really needed. In fact, to get the scaler to work at 300 MHz and slightly above, it shouldn't even be used, since it limits the high frequency response. But it is very useful at lower frequencies, below about 180 MHz, and it provides a good buffer for the really

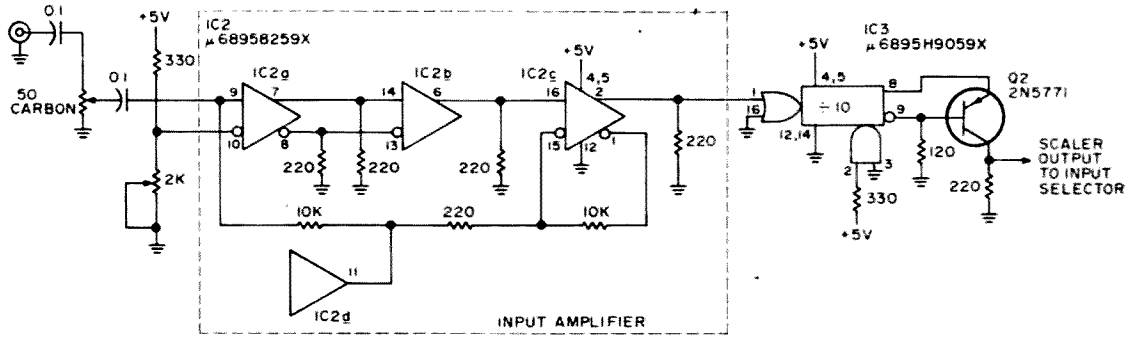


Fig. 4. VHF Prescaler. NOTE: to extend scaler range to 300 MHz (with some loss of sensitivity) eliminate all parts in dashed box, and jumper pins 2, 9, and 10 at IC2 socket.

expensive IC3 against burnout due to high input voltages.

IC3 is a special VHF prescaler IC made by Fairchild just for this use. It replaces four separate IC's used in some scalers, and even at $16 is actually cheaper than the four IC's it replaces. This particular IC is rated to work up to about 320 MHz, and some samples may work even higher than that.

These two IC's are ECL (emitter-coupled -logic) IC's, which need special interfacing with the rest of the counter, which uses TTL IC's because of their much lower cost. This is done by Q2, a level shifter and amplifier stage.

Input Selector (Fig. 5)

At first glance, the input selector may seem a little overdesigned. Sure enough, it could be replaced by a simple SPDT switch to select the output of either the low frequency input circuit or the VHF prescaler and feed it to the counters. But to avoid problems, that switch would have to be mounted right on the p.c. board, near the circuitry connected to it, and away from the input leads to prevent the possibility of feedback oscillations. To avoid the whole problem of shielding the leads and switch,

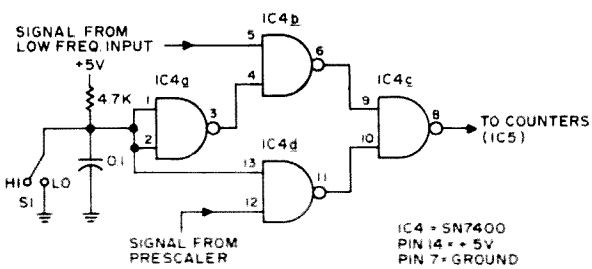


Fig. 5. Input selector.

we simply add IC4, a quad 2-input *nand* gate IC costing less than 40¢, which does the actual switching. Now a simple SPST contact on the HI-LO switch controls a small dc voltage, which energizes *either* gate IC4*b* or gate IC4*d*. A commercial counter would probably solve this problem by using a two-deck rotary switch with five inches of shaft separating the two decks, with the front deck switching the inputs between the two input circuits, and the rear deck, neatly positioned just above the circuit board, controlling the outputs. But for our purposes using IC4 is a lot more practical unless you have a switch factory next door.

Incidentally, we are going to use this trick one more time later, in the time base selector, where an SPST switch and two 40¢ IC's do the work of a DPDT switch, five coax leads, and a lot of headaches.

Counters, Latches, Decoders and Overflow (Fig. 6)

Now we come to the heart of the counter, where the actual counting is done. This circuit is divided into five almost identical stages, one for each digit displayed, plus three extra flip-flops. Most of the work is done by three types of MSI IC's. The five SN7490 IC's (IC6, IC9, IC12, IC15, and IC18) are decimal counters which count, digit by digit, the actual number of input cycles.

As soon as a count is completed, it is transferred into the five SN7475 latches (IC7, IC10, IC13, IC16, and IC19) when a strobe pulse arrives from the control circuits. These latches act as temporary memories to allow nonflickering display of the count even while the counters are reset back to

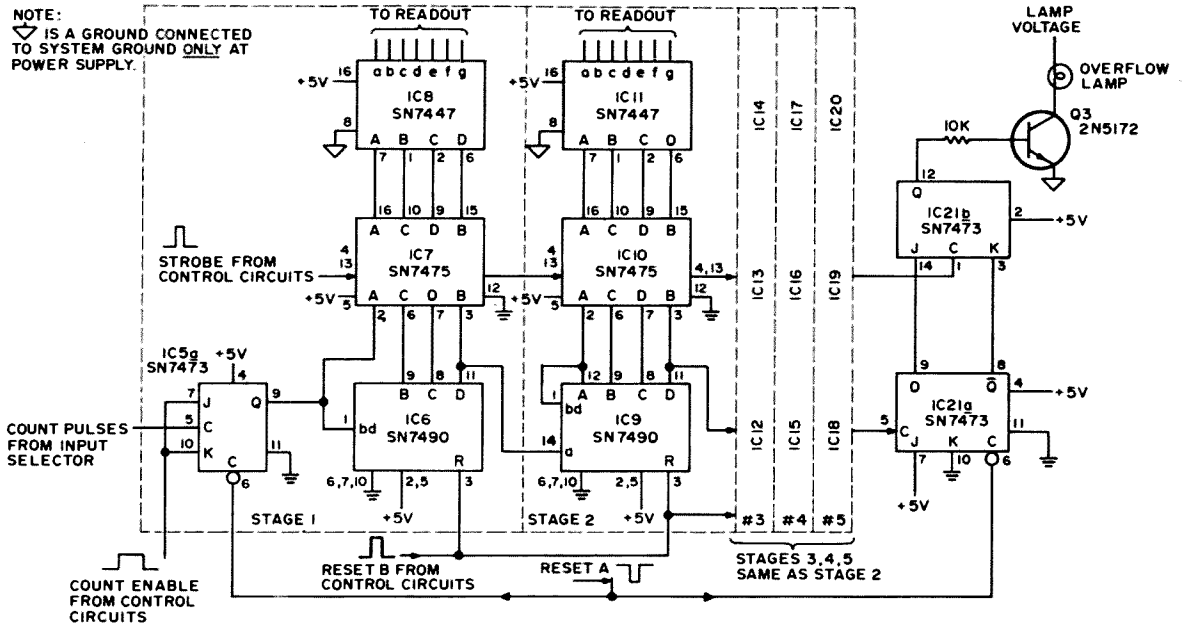


Fig. 6. Counters, latches, decoders, and overflow.

zero by a pulse on the reset B line, and then take the next count.

The BCD (binary-coded-decimal) digit from each latch is connected to the SN7447 decoders (IC8, IC11, IC14, IC17, and IC20), which translate the BCD code into the seven-segment code needed by the readouts.

The five stages of the circuit are the same except for stage 1. Part of IC6 (using pins 12 and 14) is instead replaced by an external flip-flop, IC5a. This is done because we need a foolproof way of enabling and disabling the counter for a 1-second (or 1 millisecond) intervals without disturbing the count or adding extra pulses. This is done by the Count Enable signal applied to the J and K inputs of IC5.

IC21 keeps track of any overflow from the last decade counter, IC18. If the number of cycles counted during the time period exceeds 99,999, IC18 sends a pulse to pin 5 of IC21*a* which turns on. IC21*b* acts as a one-bit latch which then remembers this condition, and lights the overflow light through Q3.

IC5 and IC21 are reset by the Reset A pulse when the counters start on a new count.

10 MHz Crystal Oscillator (Fig. 7)

The basic time reference for the counter is an AT-cut series-resonant 10 MHz crystal in a simple circuit using four gates from an SN7400 IC. Although a 2 MHz or even 100 kHz crystal could be substituted (with the saving of one or two SN7490 IC's in the time chain divider), it appears that 10 MHz crystals are more stable and need less temperature compensation. Besides, the 10 MHz crystal provides a better signal for zero-beating against 10 MHz WWV.

Time Chain Dividers (Fig. 8)

The 10 MHz signal is divided down to 1 kHz, 10 Hz, and 1 Hz by seven identical

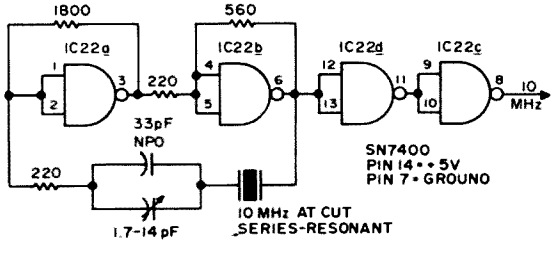


Fig. 7. 10 MHz crystal oscillator.

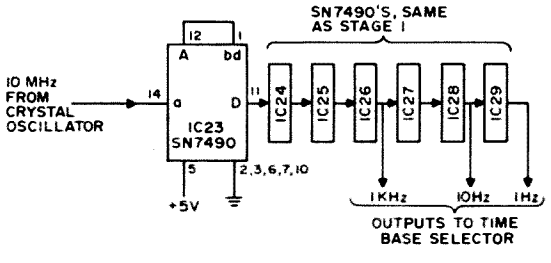


Fig. 8. Time chain dividers.

SN7490 decade counters. As mentioned above a 1 MHz crystal could be used, in which case simply omit IC23 and jumper pins 11 to 14 in its place.

Incidentally, this is a good place to get accurate frequency markers for calibration; here is a partial list of frequencies available, and where to get them:

10 MHz	IC23	pin 14
(Zero-beat against WWV, 10 MHz)		
5 MHz	IC23	pin 12
(Zero-beat against WWV, 5 and 15 MHz)		
1 MHz	IC23	pin 11
100 kHz	IC24	pin 11
50 kHz	IC25	pin 12
10 kHz	IC25	pin 11
5 kHz	IC26	pin 12
(Zero-beat against CHU, 7335 kHz)		

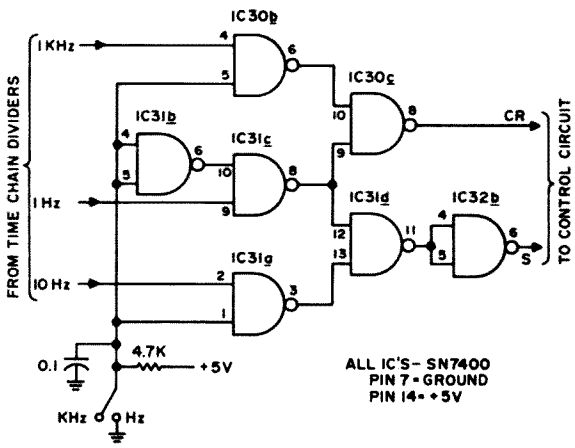


Fig. 9. Time base selector.

Time Base Selector (Fig. 9)

The time base selector receives 1 kHz, 10 Hz, and 1 Hz square waves from the time chain dividers, and sends two signals, depending on the position of the Hz-kHz switch, as follows, to the control circuits:

Switch Position	CR Output	S Output
Hz	1 Hz	1 Hz
kHz	1 kHz	10 Hz

As mentioned earlier, the switching function could just as well be done with a DPDT switch, but this would require more wiring, coax cable, and even so might cause some problems. At the expense of two IC's (IC30 and IC31, about 80¢), we simplify the wiring and eliminate some headaches as well.

The CR signal at 1 Hz or 1 kHz is eventually used to enable and reset the counter, while the S signal is eventually used to strobe data into the latches.

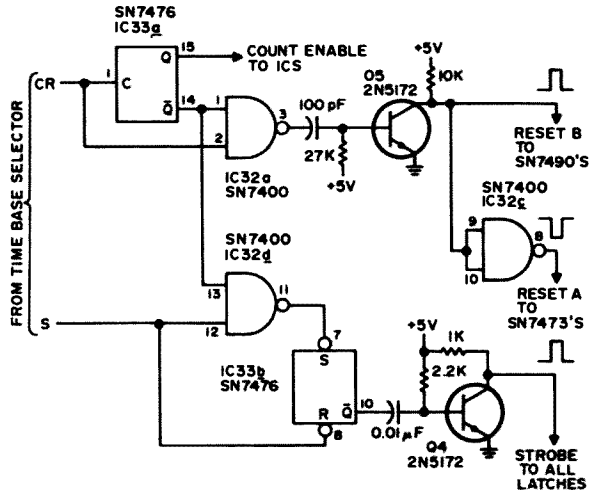


Fig. 10. Control circuits.

Control Circuits (Fig. 10)

The control circuits receive the CR and S outputs from the time base selector, and generate the count enable, resets, and strobe signals for the counters and latches.

The best way to understand the operation of this part of the counter is to look at the waveforms generated. Figure 11 shows the various signals which exist when the Hz–kHz switch is in the Hz position (they are slightly idealized – they don't always look quite so neat).

In the Hz position, the CR and S inputs are both 1 Hz square waves, though they are

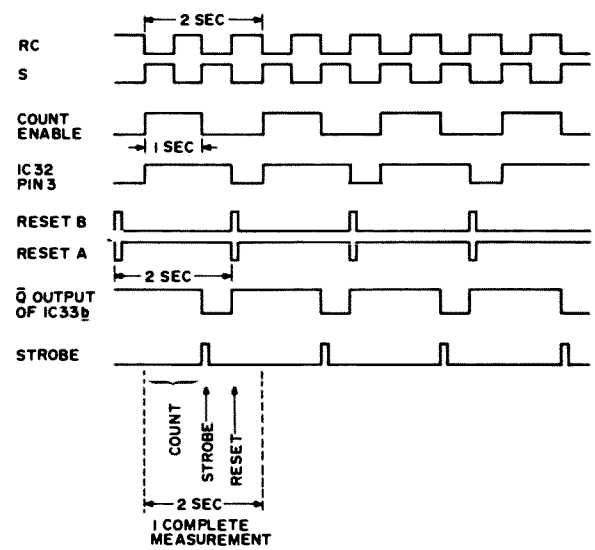


Fig. 11. Control circuit waveforms in the Hz measurement position.

out of phase. The count enable flip-flop, IC33*a*, flips back and forth at a rate of one cycle every 2 seconds. One complete measurement takes 2 seconds, as shown. First, the count enable signal goes plus for one second, during which time the counters count the input cycles. At the end of the first second, the count enable signal returns to zero, and a short positive strobe pulse strobes the counter outputs into the latches. A half-second later the reset A and reset B pulses reset the decimal counters and overflow flip-flop, in preparation for the next count.

In other words, although the actual count interval takes only one second, a complete measurement takes two seconds, and the decimal readout is updated only once every two seconds.

As shown in Fig. 12, the control circuits work quite differently when the Hz–kHz switch is in the kHz position. The count enable flip-flop, IC33*a*, flips back and forth and goes through a complete cycle in two milliseconds. The counters count the input frequency for one millisecond, then the count enable signal returns to zero, and the counters stop. One-half millisecond later the counters are reset back to zero, in preparation for the next count. In other words, the counters take 500 complete counts per second, each cycle of counting taking a total of two milliseconds.

But the big difference is in the strobe pulse. Instead of coming every two milli-

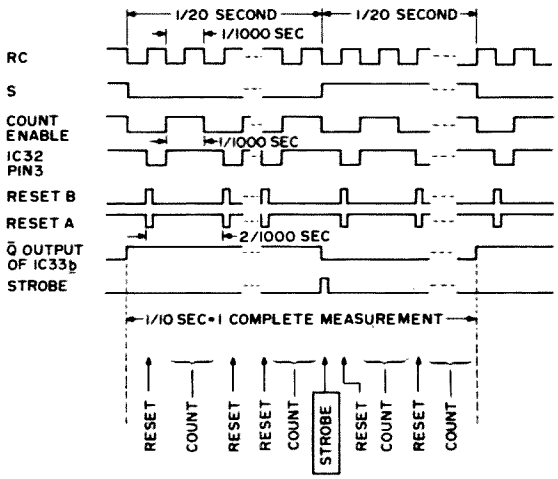


Fig. 12. Control circuit waveforms for the kHz switch position.

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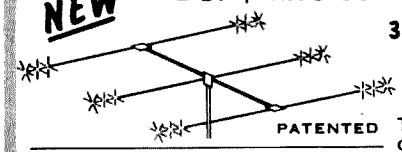
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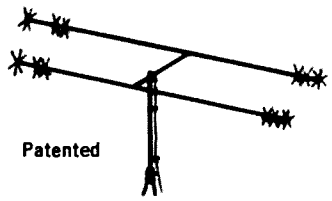
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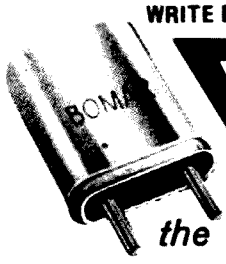
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seconds, strobe pulses come only 1/10 second apart, ten per second. Thus, even though the counters take 500 counts a second, only every fiftieth count is actually displayed. A complete measurement therefore takes a tenth of a second.

This is done intentionally, to make sure that the display flickers at a 10 Hz rate if the frequency is changing. This is important when seven-segment readouts are used. Suppose the frequency is changing very quickly. As it changes, all seven elements in each readout will be turned on, in different combinations. If this happens very fast, it appears that all the segments are lit – the readout contains all 8's. For instance, suppose that the frequency measured is 16,999,500 Hz. In the kHz position, the display will read either 16999 or 17000. If it alternates very quickly between the two readings, then all seven segments in the rightmost four readouts will be lit, and the readout will look like 18888. The control circuits purposely slow down the readout strobe rate to make sure that the readout flickers between the two values at a noticeable rate.

Types of Readout Devices

Several different readout devices can be used with this counter, depending on your desires and the condition of your wallet.

The pc board is designed for the SN7447 BCD-to-seven-segment decoders and the RCA DR-2010 Numitron indicator tubes. The interconnections between these two units are shown in Fig. 13. The Numitron tube is a 9-pin miniature glass tube with seven thin lamp filaments, viewed from the side, which plugs into a 9-pin p.c. mount socket. It *could* be soldered directly to the board, but that's not a good idea since one of the seven filaments may burn out. Because the readout is viewed from the side, it's entirely practical to put the tube right on the p.c. board, and mount the board horizontally in a cabinet. The decimal digits are 0.6 in. tall and quite bright. The price of one readout tube is about $4.50 at the time of writing, making the total for five tubes about $22.50.

A slightly cheaper seven-segment miniature readout device has been advertised in

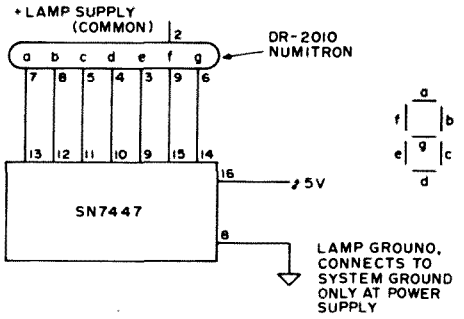


Fig. 13. Connecting the RCA Numitron (DR-2010) readout.

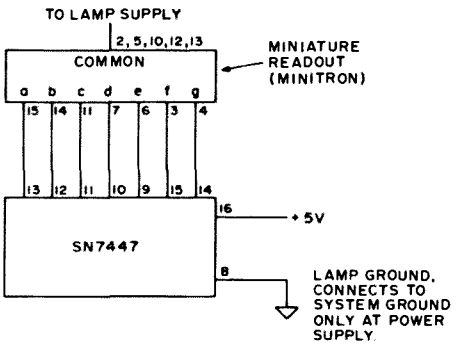


Fig. 14. Connecting the 16-pin miniature incandescent readout.

several ham magazines under various names. It works on the same principle as the Numitron, but is mounted in a tiny 16-pin package similar to a 16-pin I.C., with the numbers only 0.36 in. high. At the time of writing its price is about $3.70, or about $18.50 for a set of five. It can be connected to the SN7447 decoder as shown in Fig. 14.

Both of these readouts have one slight problem. At an applied voltage of 5V, the current per segment in the Numitron is 25 mA, and about 8 mA in the smaller readout, while the SN7447 decoder IC is rated to deliver up to 20 mA. But the surge current into an incandescent lamp filament when first turned on is about 12 times the rated current – the Numitron takes about 300 mA surge, while the miniature type takes about 100 mA. Both of these values can overload the SN7447.

One way to avoid this problem is to use the SN7447A decoder, which is rated for somewhat more current than the SN7447. Another is to use less than 5V. Some people suggest that the lamp voltage be taken from an unregulated 3–4V. An excellent choice is a full-wave rectified, but unfiltered, 3.15V (see Fig. 17 for power supply connections).

Another problem is associated with the high surge currents. The lamp voltage and the ground connection for the SN7447 must go directly to the power supply, separate from the normal power leads for the rest of the unit.

A really elegant, though more expensive method is to use a light-emitting-diode seven segment readout such as Monsanto's MAN-1, or -3, the Litronix 10A, or some of the Hewlett-Packard units. At the time of writing the minimum cost in unit quantities is about $8.50 each ($42.50 for a set of five), but many people feel that by the time this article appears the LED price may be close to the incandescent readouts.

The MAN-3 has a number height of about 0.1 in. while the MAN-1 and Litronix 10A are about 0.3 in. Figure 15 shows the connections from the SN7447 to the MAN-1 or 10A. Both LEDs are mounted in a miniature 14-pin package similar to a 14-pin IC.

Both the LED readout and the miniature incandescent readout are IC-like packages which have to be viewed from *above*. This means that it's not practical to mount them

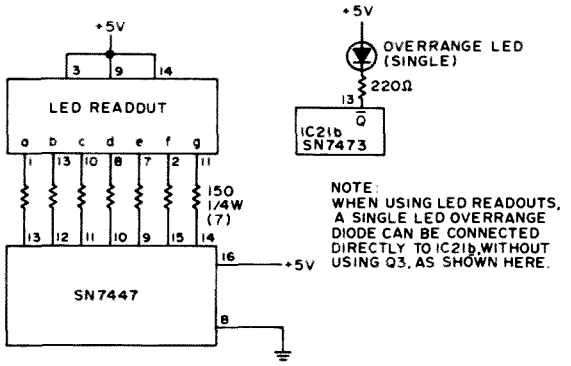


Fig. 15. Connecting the MAN-1, 10A, and LED-700 LED readouts.

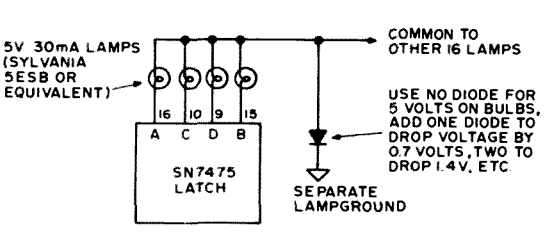


Fig. 16. Connecting four lamps to SN7475 latch, to reduce cost.

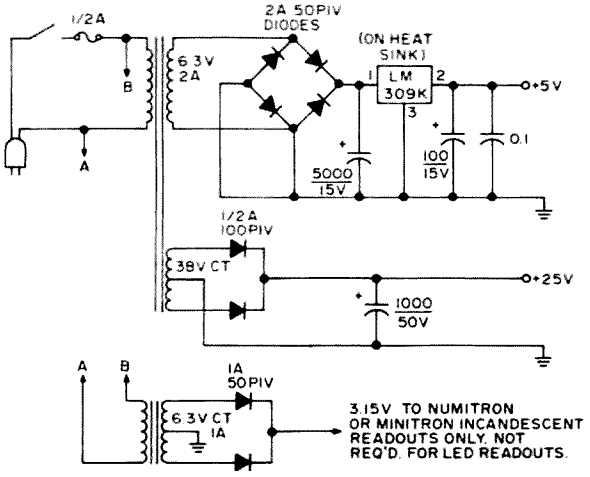


Fig. 17. Power supply.

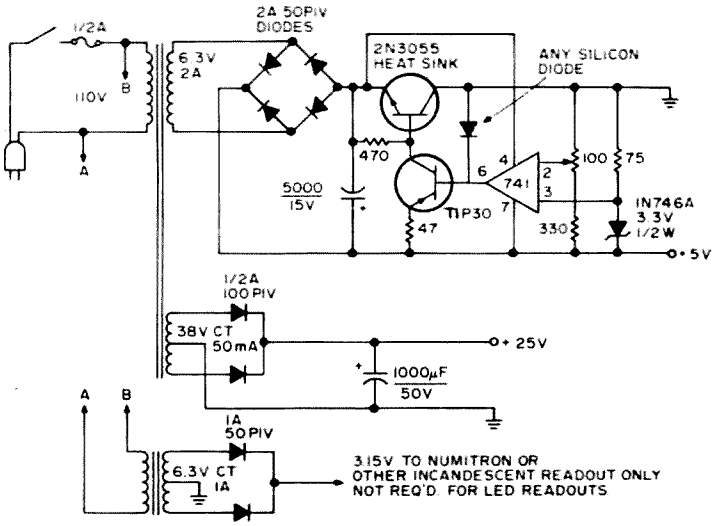


Fig. 18. Alternate power supply.

on the same board as the rest of the counter unless you like to look down from above. The best way to mount them is on a small etched or perforated board which stands up vertically right in front of the main p.c. board.

Power Supply (Figs. 17 and 18)

A good power supply is a very important part of any digital system. It must be well filtered and well regulated, since integrated circuits are very sensitive to noise on the power lines. Most important, the power supply voltage to the IC's should be between +4.75 and +5.25V, and must not go above 5.5V or so to avoid damage to them.

The counter needs +5V at ±5% regulation at about 1.5A, +25V at about 10 mA for the FET input amplifier, and a lamp voltage of about 3V and roughly 1A if incandescent readouts are used (LED readouts work directly off the +5V supply).

The simplest +5V power supply uses an LM-309K 5V regulator IC, available from a number of sources at a low price. Shown in Fig. 17, all it has is a bridge rectifier, three filter capacitors, and the regulator. Figure 18 shows an alternate design, which is capable of somewhat more current output and therefore runs cooler. This design happens to be the one used in our prototype, since it is current limiting and short-circuit proof.

In our units, the +25V supply uses a 38V center-tapped transformer winding and a simple full-wave rectifier. Since only about 10 mA of current is required, a 1000 μF filter capacitor is enough filtering. Since 38V transformers are not that common, you may use a 16V bell transformer in a bridge rectifier circuit to give the same output voltage; the p.c. board has room for the extra two diodes in the bridge. In fact, any transformer that will provide 20–30V of dc will work. Regulation is not too important.

If you use the Numitron or Minitron incandescent readouts, the 3V lamp voltage comes from a separate 6.3V center-tapped filament transformer, as shown in Figs. 17 and 18. The two rectifier diodes mount on the main p.c. board. If you use the LED readouts, the transformer and diodes are not needed.

Since the TTL IC's are not only sensitive to noise, but generate sharp spikes on the 5V power line as well, adequate filtering is very important. In addition to a hefty power supply filter capacitor, there are small 0.1 and 0.01 μF disk capacitors scattered around the p.c. board, bypassing the +5V line to ground. These are essential to eliminate the voltage spikes as close to the IC's as possible. In fact, the two IC's in the VHF prescaler have 0.01 μF disk capacitors soldered directly under them, on the copper side of the board, connected right on the two power supply pins, just to keep out noise and prevent problems.

In the third part of this article, we will show you how the p.c. board is laid out, where to place the parts, and how to hook the whole thing up.

. . .K2OAW

Note:
Circuit boards and parts for the complete counter are available through Circuit Specialists, Box 3047, Scottsdale AZ 85251. Ed.

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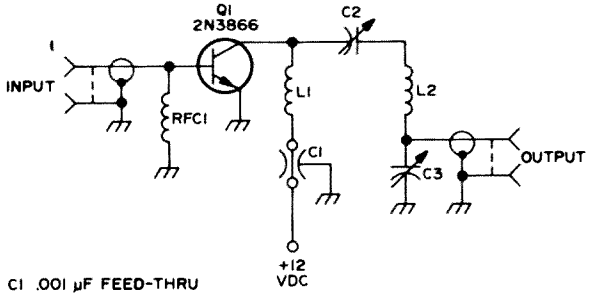
EXPERIMENTAL SOLID STATE VHF AMPLIFIER

A couple of articles in the amateur literature have outlined the merits and characteristics of some of the relatively new power transistors for VHF power amplification.[1,2] The article by Franson is extremely valuable; it describes characteristics and typical circuits with a good section on impedance matching between stages and to the output load.

After careful reading of some of the published information, a 2N3866 transistor was obtained. This type was selected mainly because of its low cost and 1W output rating. A watt of output at 2 meters puts a solid state transmitter in pretty much the same class as the little transceivers so popular for local contacts on the band.

While the circuit designs have been worked out on paper, not much has been shown on the practical construction methods required to obtain maximum efficiency in a power amplifier stage. A quick check in breadboard fashion showed that the 2N3866 would indeed provide considerable power gain at 144 MHz, and seemed to be quite stable in operation. For the preliminary test, the transistor was mounted inside a small minibox with the emitter lead soldered directly to a ground terminal bolted to the chassis, and the other two transistor leads soldered to standoff terminals close to the transistor body. Input and output jacks were mounted on each end as well as a feedthrough capacitor on the top of the box for the application of B-plus. This arrangement provided a check on the circuit, but the power output obtainable was well below what the data sheet indicated it should be.

Both articles mentioned point out the necessity of using the shortest possible leads in the construction of this type amplifier, and indicate the construction which should be used for maximum efficiency at VHF. It



C1 .001 μF FEED-THRU
C2 4-30 pF CERAMIC TRIMMER
C3 1-30 pF PISTON TRIMMER
L1 2-1/2 TURNS NO. 16 AWG, 3/8 in. DIA., 3/8 in. LONG.
L2 3-1/2 TURNS NO. 16 AWG, 3/8 in. DIA., 1/2 in. LONG.
RFC1-24 TURNS 28 AWG ENAMEL ON 1/2W RESISTOR

Fig. 1A. Schematic diagram.

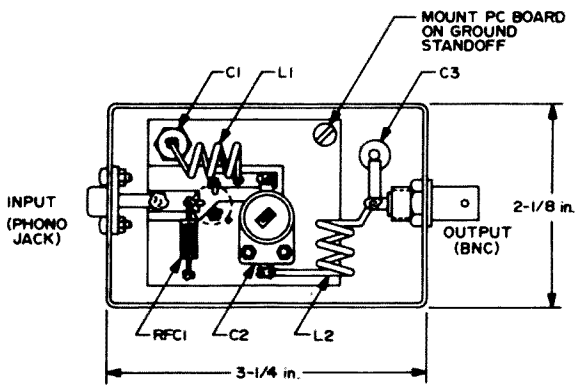


Fig. 1B. 144 MHz solid state Class C amplifier.

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was obvious that the breadboard amplifier did not meet these requirements, especially in regard to grounding the emitter lead by as direct a path as possible. The emitter lead was probably somewhat over an inch in length after passing through the solder lug to the chassis ground. Also, the tank coils and rf choke in the base circuit were not mounted as they should have been.

With these inefficiencies in mind, the circuit board pattern shown in Fig. 2

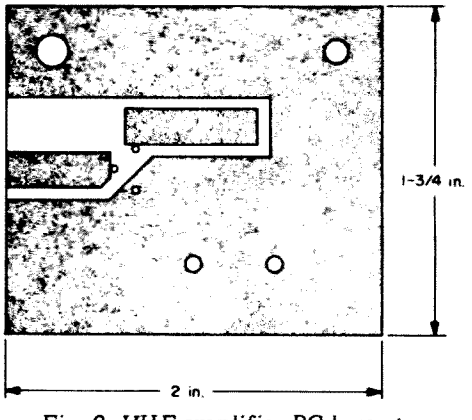


Fig. 2. VHF amplifier PC layout.
40% of original size (shoot at 250% to make this layout 2.775 times larger than shown).

evolved. The copper clad board provides a good ground plane for the amplifier, and soldering the transistor directly to the board provides the shortest possible leads, especially for the emitter termination. The wide strips of copper at the collector and base connections give low inductance connections at these points, another consideration mentioned in both articles.

As shown in the top view of the assembly (Fig. 1B) the input jack is soldered directly to the base connection on the circuit board and also serves as a support for the board on this end. The other end of the board is supported on a grounded standoff. It was thought best to use just one standoff between the circuit board ground pattern and the main minibox chassis ground, although the effects of ground loops with a more rigid multiple point mounting were not investigated. At any rate, the construction method shown is plenty rigid, even for mobile applications in amateur service.

C2 is soldered directly to the collector strip on the circuit board eliminating a lead at this point, and L2 goes between the other side of C2 and the output port. The output loading capacitor, C3, is a piston trimmer with one side bolted directly to chassis ground. A flat strip of 1/8 in. copper was used for the short connection from the high side of C3 to the output.

The amplifier circuit was the same as the one in Fig. 4A in the article by Franson. This particular circuit is a good choice to obtain an impedance match between the collector and the 50Ω output desired, since the impedance level at the collector is pretty much set by the supply voltage and power output level, in this case somewhere in the area of 12V and 1W of output. The circuit is repeated in Fig. 1A.

With the amplifier built on the circuit board, and mounted inside the minibox, the power output available immediately jumped up to 1W or more. Best of all, the amplifier tuned up and acted just like one might on the low frequency bands.

In order to run the transistor at the relatively "high" level necessary for a watt of output, some sort of heatsink for the transistor should be provided. A flat plate of

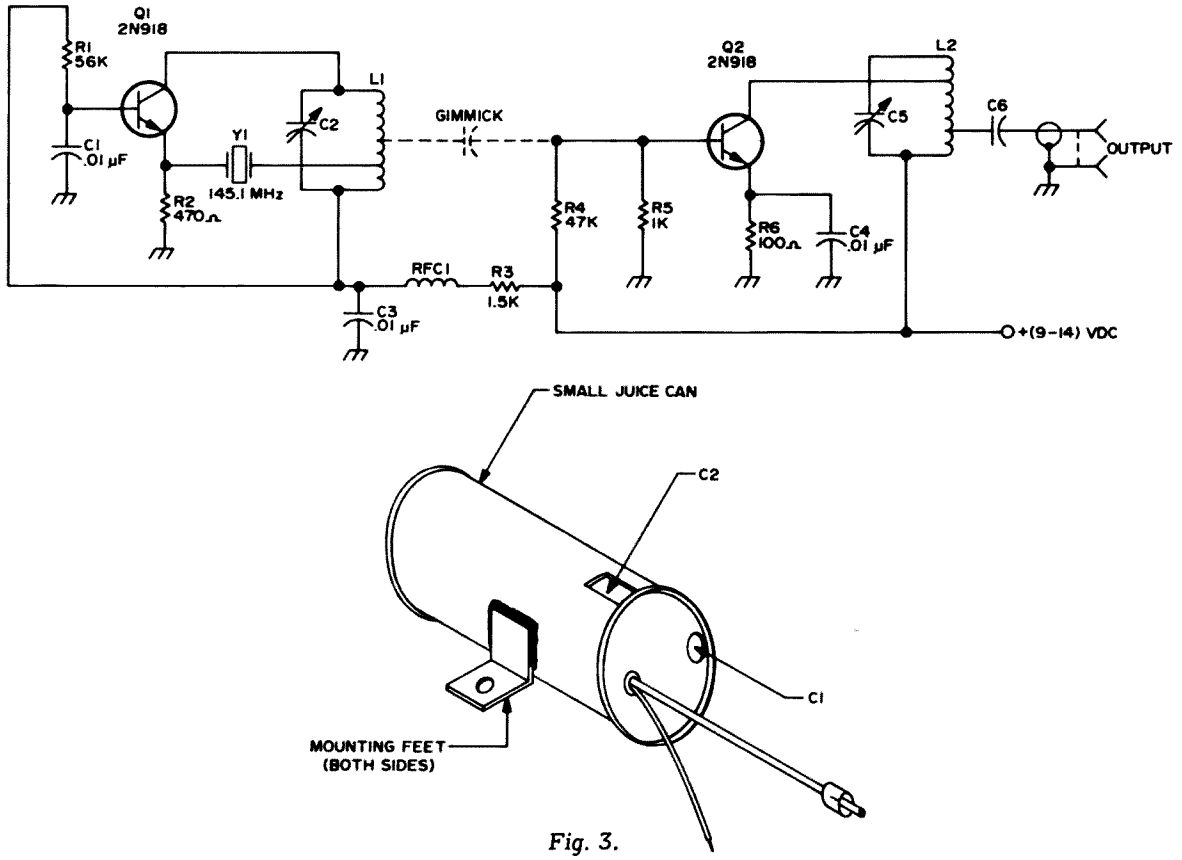


Fig. 3.

aluminum was tried by reaming a hole to fit over the transistor body and bolting it directly to the circuit board. However, this arrangement added so much capacity from collector to ground that the circuit failed to work with the heatsink in place.

As a result, a small heatsink clip was fashioned from scrap metal to slip over the transistor in much the same manner as the commercial clips available. This radiator provides enough cooling for normal power levels. The output flattens out above a watt anyway, so there is no advantage in pushing the stage any further than a couple of watts of dc input. Actually, the transistor ratings indicate that it could probably be operated at this level without a heatsink, although the clip is insurance well worth the effort.

As it turns out, actual checking of amplifier performance is simple with this type of construction, and in many amateur applications the source of a signal to drive the stage may be more difficult to obtain. For quick checks the output from a small two-meter transmitter could be used with a suitable attenuator to knock down the power to the few milliwatts required.

As a matter of interest, the circuit of a little 144 MHz signal source is shown in Fig. 3. This was built up on a small piece of vectorboard and mounted inside a small frozen orange juice can. It provides a very convenient signal source with a few milliwatts of output, which is just right to drive something like the 2N3866. The critical part of the signal generator, of course, is the 145 MHz overtone crystal.

The test amplifier shown not only provides a convenient and efficient way of checking transistor performance, but it can be used as an integral part of a small two-meter transmitter. With a crystal oscillator like that in Fig. 3 and a small modulator, the 2N3866 amplifier provides a simple little transmitter with results equivalent to some of the small commercial two-meter rigs. The applications for mobile and portable work are obvious.

. . .W9ZTK

References.

1. David F. Becker, "More Power on 144 MHz with Transistors" *QST* August 1969.
2. Paul Franson, "How to Use RF Power Transistors" *Ham Radio* January 1970.

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THE PHASE-LOCK LOOP

PART ONE

Reprinted from Amateur Radio, *Journal of the Wireless Institute of Australia.*

This is the first of two articles written with a view to acquainting amateurs with the principles of the phase-lock loop. Applications of the phase-lock loop are outlined and the use of a phase-lock loop as an optimum FM discriminator is discussed.

The basic phase-lock loop is shown in block diagram form in Fig. 1. It comprises three basic components:

(1) A phase detector (Fig. 2),
(2) A low pass filter (Fig. 3),
(3) A voltage controlled oscillator (VCO) (Fig. 4).

The phase of a periodic input signal and that of the VCO is compared by the phase detector; output of the phase detector is a measure of the phase difference between its two inputs. This difference voltage is then filtered by the loop filter and applied to the VCO. Control voltage on the VCO changes the frequency in a direction that reduces the phase difference between the input signal and the VCO.

When the loop is "locked" the control voltage is such that the frequency of the VCO is exactly equal to the average frequency of the input signal.

Suppose now that the input signal carries information in its phase or frequency; this signal is inevitably corrupted by additive noise. Suppose also that the VCO is the "local oscillator" in some form of receiver. The task of such a phase- lock "receiver" is to reproduce the original signal while removing as much of the noise as possible. If the "local oscillator" could be locked to the input signal and made insensitive to the random noise on this signal, then the input signal could be reconstructed.

The input to the loop is a noisy signal, whereas the output of the VCO is a cleaned-up version of the input. To suppress noise, the error output signal from the phase detector is averaged over some length of time by the loop filter, and the averaged error is then used to control the frequency of the oscillator. It is reasonable, therefore, to consider the loop as a kind of filter that passes signals and rejects noise.

Two important characteristics of the filter are that the bandwidth can be very small

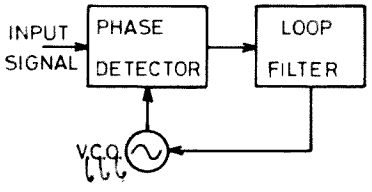


Fig. 1. Basic phase lock loop.

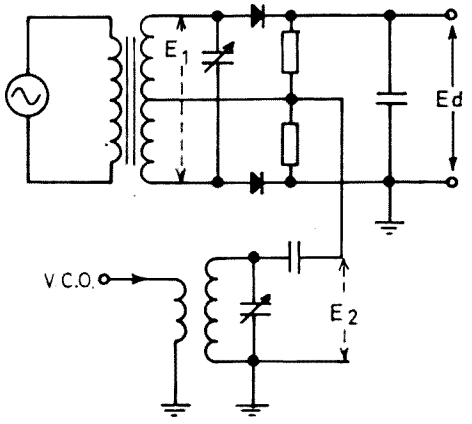


Fig. 2. Typical phase detector. If the signal input is Er sin (2 π ft) and the VCO is E2 cos (2 π ft + o) then the output of the detector is Ed≈ 2E2 sin θ or for small θ, Ed ∝ E2 θ for E2 > E1, i.e. the output voltage is proportional to the phase difference between the signal input and the VCO.

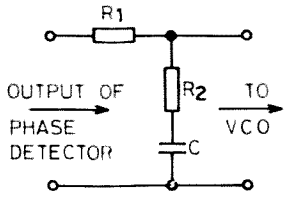


Fig. 3. Typical low pass filter. The transfer function of this filter is

$$H(S) = \frac{S\,C\,R2 + 1}{S\,C\,(R1 + R2)} + 1$$

where S is the complex variable.

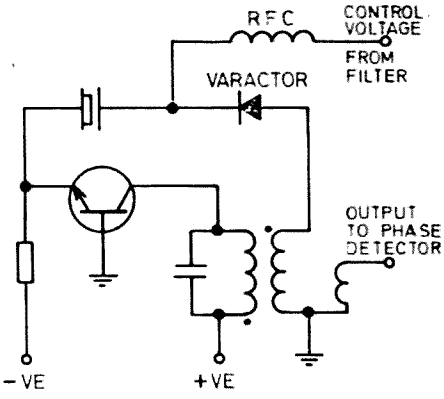


Fig. 4. Typical voltage controlled oscillator.

and the filter automatically tracks the signal frequency. Narrow bandwidth is capable of rejecting large amounts of noise; it is not at all unusual for a phase-lock loop to recover a signal deeply embedded in noise.

One application of the phase-lock loop is as the local oscillator in a synchronous or homodyne receiver. In essence this receiver consists of nothing but a local oscillator, a mixer, and an audio amplifier. To operate, the oscillator has to be adjusted to exactly the same frequency as the carrier of the incoming signal which is then converted to an intermediate frequency of zero Hz. Output of the mixer contains demodulated information that is carried as sidebands by the signal. Correct tuning of the local oscillator is essential to synchronous reception; any frequency error whatsoever will hopelessly garble the information. Furthermore, phase of the local oscillator must agree, very closely, with the received carrier phase. In other words. the local oscillator must be phase-locked to the incoming signal.

Another common application arises in television receivers. The flywheel synchronisers in present-day TV receivers are really phase-locked loops.

Space use of phase-lock began with the first American (Russian?) artificial satellites. These carried 10 mW. CW transmitters; received signals were correspondingly weak. Furthermore, Doppler shift made the exact frequency uncertain. At the 108 MHz frequency used, the Doppler shift could range over a ±3 kHz interval. Hence an ordinary fixed-tuned receiver would require at least a 6 kHz bandwidth for a signal that could be contained in something like a 6 Hz bandwidth. This entails a noise penalty (noise is directly proportional to bandwidth) of 1,000 times, i.e. 30 dB. Such penalties are intolerable and that is why narrow-band phase-locked tracking receivers are used.

Noise can be rejected by a narrow-band filter, but if the filter is fixed, the signal will almost never be within the passband. For a narrow filter to be usable it must be capable of tracking the signal. A phase-locked loop is capable of providing both the narrow bandwidth and tracking that are needed. Current applications of phase-lock include:

(1) Perfect afc (automatic frequency control) of receivers;

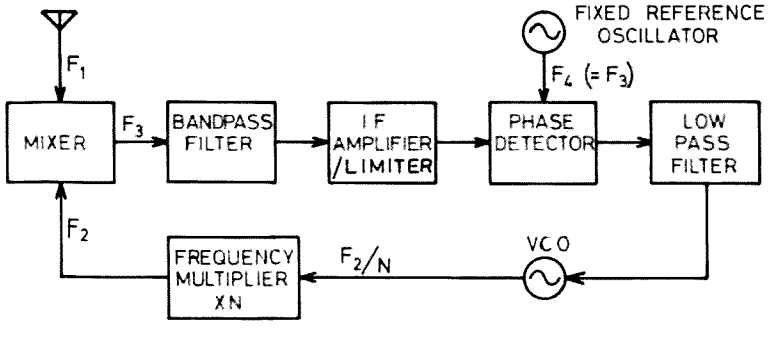


Fig. 5. Basic phase-lock receiver.

(2) P.c.m. telemetry bit synchronisation;
(3) Frequency multipliers and dividers;
(4) Coherent transponders;
(5) Noisy oscillators can be enclosed in a loop and locked to a clean signal; if the loop has wide bandwidth, the oscillator tracks out its own noise and the output is greatly cleaned up.
(6) A phase-locked loop can be used as a frequency demodulator; in which service it gives superior performance to conventional discriminators.

A simplified diagram of a superheterodyne phase-lock receiver is shown in Fig. 5. The principal difference between this and a conventional receiver is that the local oscillator tracks the input signal, allowing a much narrower i-f bandwidth. The smallness of the bandwidth is limited only by error and stability considerations.

Consider now the output of the phase detector; this is proportional to the phase difference between the i-f signal and that of the local reference oscillator. As the input signal varies in frequency when modulated, so the output of the phase detector will vary in sympathy with the modulation in order that the VCO track with the incoming signal to keep the frequency and phase of the i-f signal correct. Thus this voltage from the phase detector is a demodulated version of the FM signal. Direct use of the phase-detector output is unsatisfactory since it would be very noisy and unfiltered. Normally the demodulated signal is taken from the loop low-pass filter.

A simpler method for using a phase-lock loop as an FM demodulator is shown in Fig. 6; performance is of course not as good as a fully fledged phase-lock receiver, but practical advantages are obvious.

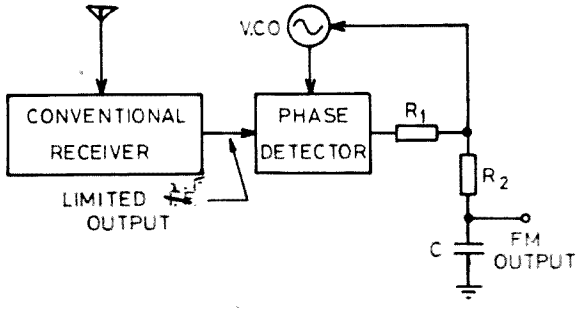


Fig. 6. Loop used as discriminator.

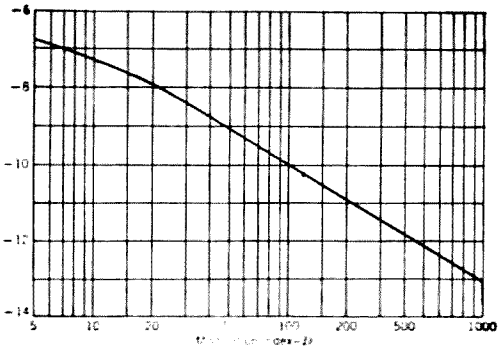


Fig. 7. Threshold for Random Modulation (Ref. 1).

The threshold of a conventional discriminator is considered to be +10fN SNR (signal-to-noise ratio) at the input to the limiter, whereas the threshold SNR for the phase-lock loop demodulator is indicated in Fig. 7.

Conclusions

The following conclusions may be drawn regarding discriminators:

(1) At high input SNR's there is no appreciable difference between phase-locked and conventional types.
(2) A phase-locked loop will have a lower threshold than the +10 dB of a conventional discriminator.
(3) The improvement that can be gained depends on the modulation of the input signal.
(4) For best results , the loop should be specifically designed for the modulation actually present.
(5) Premodulating filtering can provide better performance..

Next month, in the second article on this subject, a practical FM demodulator using an IC will be discussed. This is of the "add on" variety as in Fig. 6.

.. VK4ZFD

REFERENCES

1. Gardner, F. M.: "Phaselock Techniques," Wiley, 1966.
2. Lindsey, W. C.: "Optimum Frequency Demodulation," J.P.L. Space Programmes Summary No. 37-26, vol. iv., pp. 227-237, April 1964.
3. Lathi, B. P.: "Communication Systems," Wiley, N.Y. 1968.
4. McMullen, C. W.: "Communication Theory Principles," Macmillan, N.Y. 1968.
5. Harman, W. W.: "Principles of the Statistical Theory of Communication," McGraw Hill, N.Y. 1963.

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VHF CONVERTERS
A Building Block Approach

Dual insulated gate MOSFETS have taken a lot of the drudgery and black magic out of VHF front-end design. Using these devices, it is possible to construct stable, high-gain, low-noise rf amps and quiet, "birdie" free mixers using a few basic circuits without the use of exotic test equipment or hours of fiddling with temperamental adjustments.

Dual insulated gate MOSFETS offer inherent advantages not found in any other device. They handle strong signals and show cross-modulation characteristics as good as those of a well-designed pentode

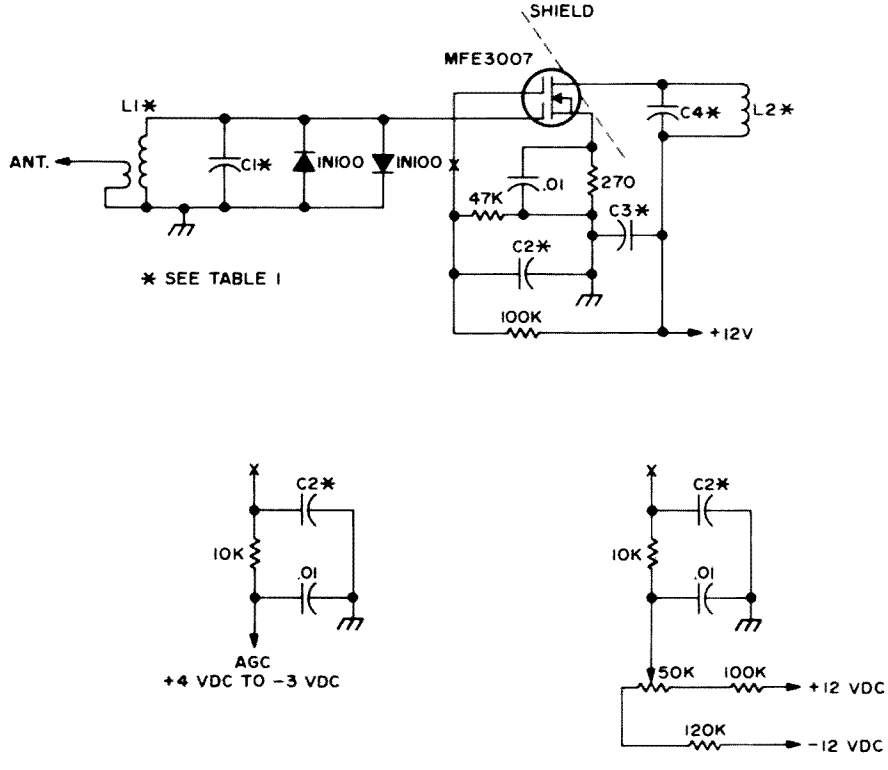


Fig. 1. RF amplifier.

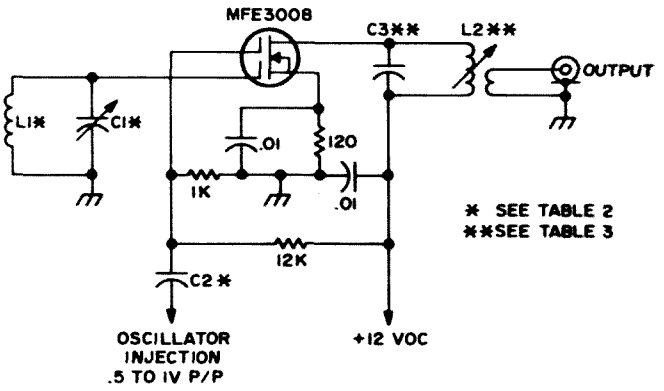


Fig. 2. Mixer.

tube stage, yet they provide noise figures and gains which cannot be excelled with anything but a parametric amplifier. They are quite stable and predictable. They have very low input and output capacitances, and are high-impedance devices, permitting comparatively easy design of tuned circuits well into the VHF range. They are relatively uniform device-to-device of the same designation, and maintain their characteristics over a broad range of frequencies. If desired, agc is easy to apply, though it will not, of course, normally be used in VHF front ends.

Because of all these advantages which are so happily combined in one family of devices, it is possible to use a building-block method for designing VHF converters and rf amps up to 432 MHz. Only the frequency-dependent components have to be changed in building over a wide range of frequencies. This has never been possible with other devices.

MOSFETS do, however, have certain limitations because of their extreme susceptibility to gate shorts caused by excessive rf voltages or static charges. Therefore, in handling and installation, it is important to circumspectly observe some precautions.

I have read of many elaborate safeguards to be taken in handling MOSFETS, including grounding the soldering gun tip

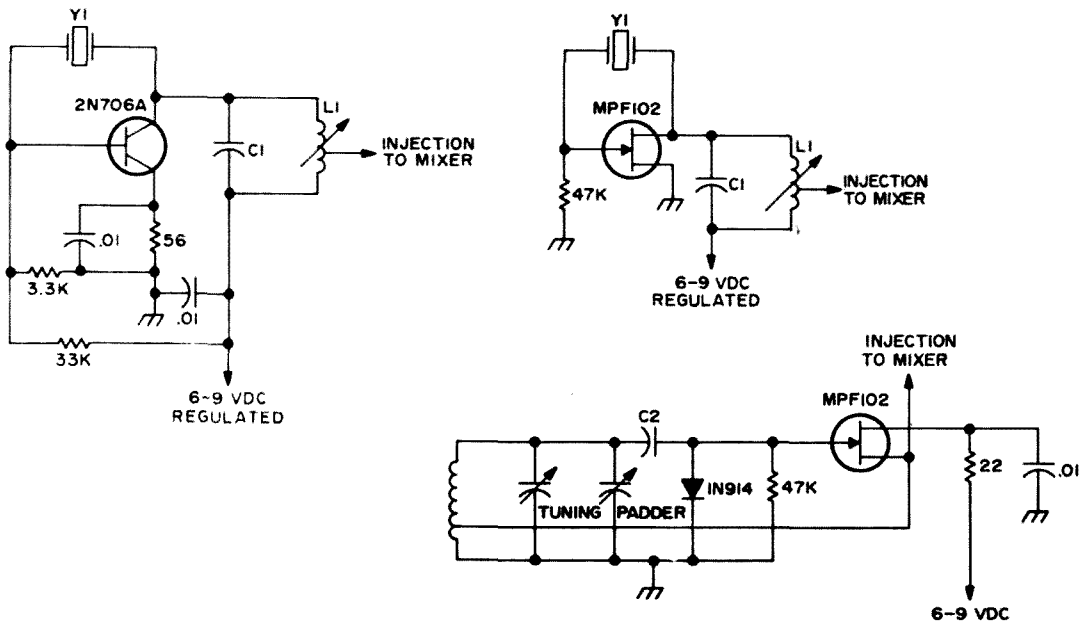


Fig. 3. Oscillators.

before soldering them in. I definitely prefer to use sockets, and with a little forethought this is possible in just about any VHF design. The use of sockets eliminates many potential hazards to the delicate MOSFET gates. NEVER INSERT OR REMOVE A MOSFET WHILE ANY VOLTAGES AT ALL APPEAR ON THE SOCKET TERMINALS!!!! Once a MOSFET is installed in a circuit, the problem of static charge damage is pretty well taken care of. But while preparing the device for installation, caution must be excercised. Even minute discharges such as those from your fingers on a dry day are dangerous. The method I use to avoid problems is so simple that it seems to have been overlooked. At least, I have never heard of it elsewhere: I use water.

Have a pan of water close by when you prepare to install a MOSFET. Before removing the packing short, immerse your hands, the MOSFET, and all tools which will contact it in the water. Since the MOSFET is hermetically sealed, it won't be damaged. Then remove the short, trim and form the leads, and insert it in the socket. Be sure you keep everything wet until it's finally installed. I guarantee you'll avoid any shorted-gate problems if you use this method.

Precautions must also be taken in the circuitry and mechanical design of equipment using MOSFETS which will be located in a strong rf field, as in a typical amateur installation. It is advisable to use *two* good relays in series between the transmitter output and the converter input to provide the greatest possible isolation from the transmitter. In the transmit position, the converter input can be shorted to ground by the extra relay. Back-to-back diodes (1N100s are fine) should be connected across the input gate of the first rf amp to limit the rf voltage appearing there to about 0.7V peak-to-peak. In addition, the lead from the input coil to the input gate and the lead from the input connector to the coil should be kept as short as possible to minimize any stray coupling. The entire converter should be carefully *sealed* to rf to keep everything out of the converter except what comes through the antenna input connector; and all stages

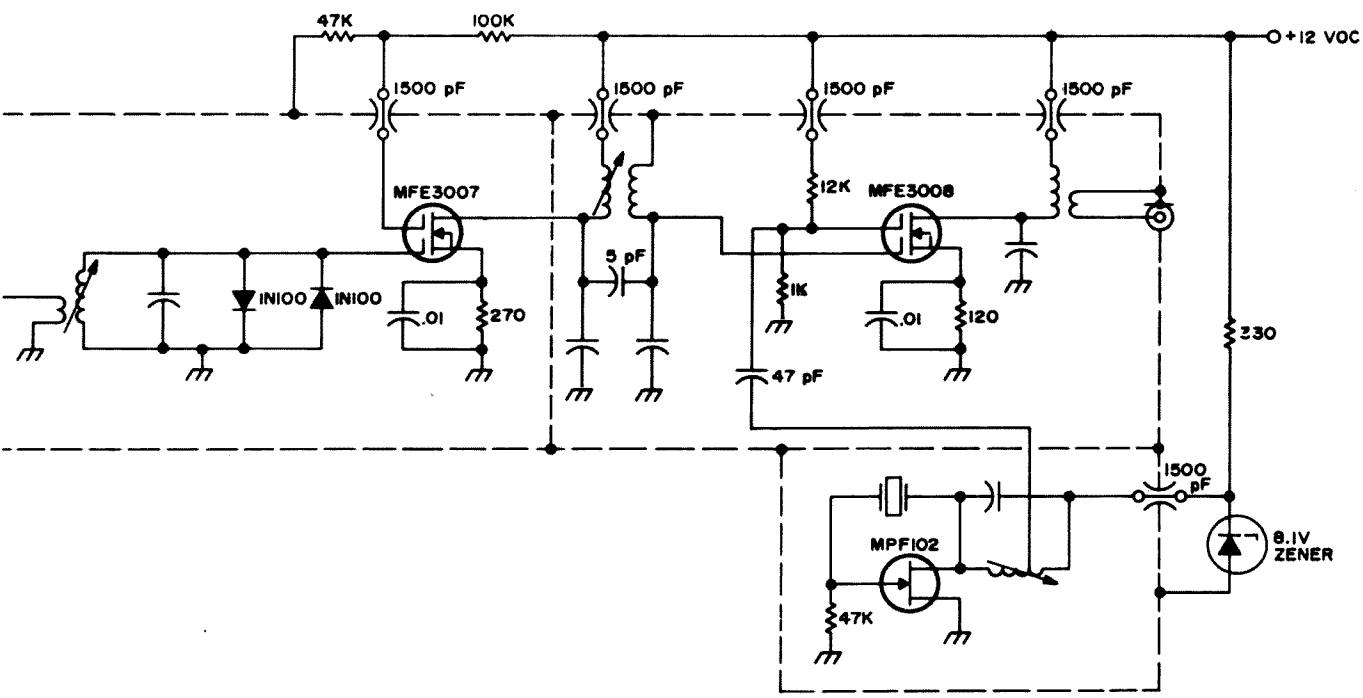


Fig. 4. 50 MHz converter. Output link should be 3 turns over output coil to match low impedance receiver input. Note the use of feedthrough capacitors for all dc voltages and shielding between all stages. Tuned circuit values will be found in Tables I–IV. Output coil of oscillator is tapped for injection voltage. It should run between 2 and 4 turns from cold end for .5 to 1V peak-to-peak, but this will vary somewhat from crystal to crystal.

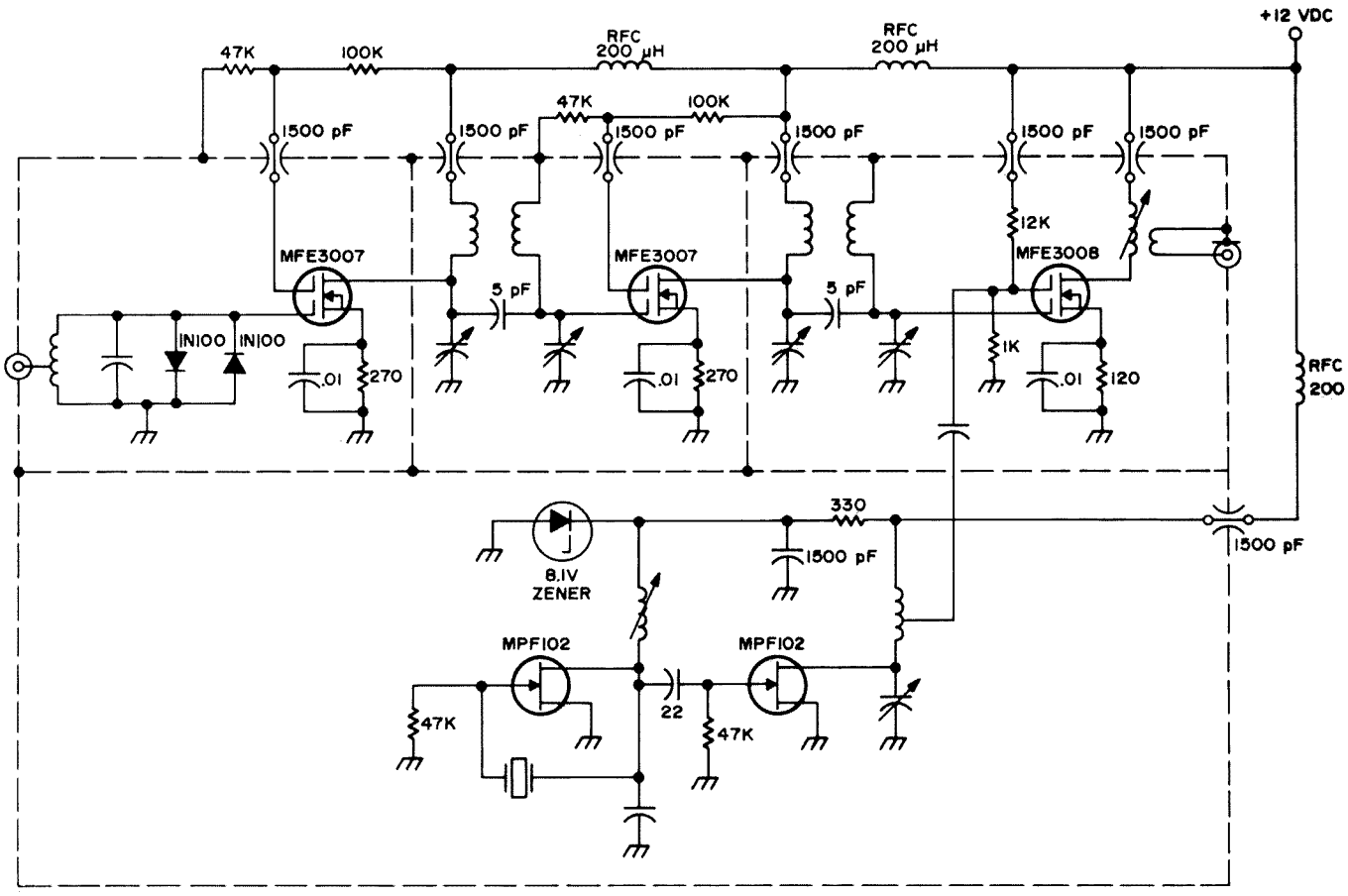


Fig. 5. Schematic of a converter for 144 or 220 MHz illustrates the use of the MPF102 JFET as a multiplier. Note that it is necessary to tap down on the coil to achieve proper injection voltage. Tuned circuit values will be found in Tables I–IV.

should be carefully sealed from one another. The converter diagrams illustrate the kind of layout required as well as the use of feedthrough capacitors.

Mixers shown use the Motorola MFE3008, while the rf amps use the MFE3007. RCA manufactures a wide range of MOSFETS which can be substituted directly for these devices, but I have found the Motorola MOSFETS easier to come by.

The basic rf amplifier building block will usually be used straight through at maximum gain in VHF installations. However, gain control options are shown. To apply them, break the lead in Gate 2 at "X" and add the circuitry shown in the

TABLE I: Rf stage components

Freq.	L1, L2	C1, C4	C2, C3	Typ. gain
50 MHz	8 turns #22, close wound on ¼" slug tuned form. Three turn link over L1 for input.	10 pF	1500 pF	24 dB
144 MHz	4 turns #20 tinned, 5/6" diameter, ½" long. Tap L1 1 turn from ground end for input.	8 pF plastic tubular trimmer	1000 pF	20 dB
220 MHz	4 turns #20 tinned, 5/6" diameter, ¾" long. Tap 1 turn from ground end for input.	8 pF plastic tubular trimmer	1000 pF	18 dB
432 MHz	#12 wire, 2½" long. Tap L1 at 1", L2 at 1 ¾". (See Fig. 9)	3 pF plastic tubular trimmer	500 pF	12 dB

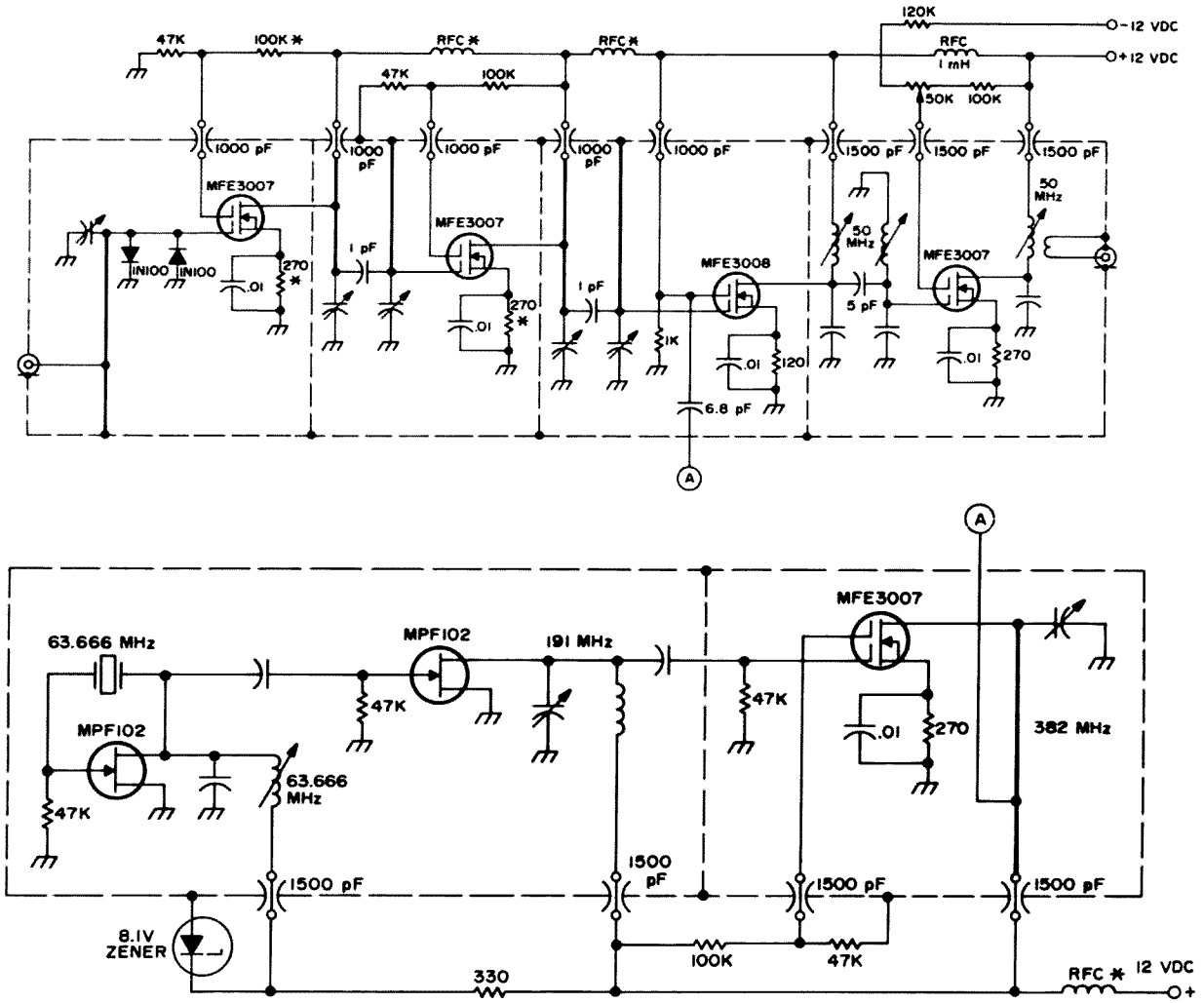


Fig. 6. 432 MHz converter illustrates the use of the MFE3007 as a doubler, to assure adequate injection voltage. Note that output to mixer is, again, tapped down on the tank coil. If leads are not kept extremely short, it may be necessary to parallel 220 pF ceramics with the .01 μF source bypasses shown. The i-f amplifier may not be necessary, particularly if the converter is used with the 50 MHz converter shown in Fig. 4. I-f gain control is optional. Tuned circuit values are shown in the tables.

options. With agc or rf gain control, the basic rf amp makes a fine i-f amp for use at low frequencies, or following a converter. Frequency dependent parts are marked with an asterisk, and values are broken down in Table I. RF stages can easily be cascaded by coupling L2 of the first stage to LI of the second stage using 2 or 3 turn links or twisted wire "gimmick" capacitors. One stage gives more than adequate gain at 6m and below, but from 2m up, two stages are advisable for optimum performance. The basic rf amp building block can also be used as a multiplier in oscillator chains, though for economy and simplicity, the MPF 102 is preferred. Typical noise figure is under 3 dB. Approximate gain figures will be found in Table I.

Components marked with a single asterisk are dependent on the input frequency, and those marked with a double asterisk are dependent on the i-f frequency. For values, refer to Tables II and III respectively. Approximate conversion gain will be found in Table II.

*RFCs are #28 closewound over 47K ½W resistors, 8 to 10 turns. Noise figure can be improved by increasing source resistance and decreasing 100K resistor to keep G2 to source voltage at approximately 4V. Maximum possible source resistance is 750Ω. There will be some compromise in gain, and the noise figure can only be decreased by 1 dB at best, so it generally is not worthwhile.

There are several possibilities for basic oscillator building blocks. There is one factor which must be taken into consideration which is often ignored: the level of the injection voltage. With MOSFET mixers, it is advisable to keep the heterodyne voltage between .5 and 1V peak-to-peak. A voltage this low will not maximize conversion gain, but it will insure minimum spurious responses. Even at .5V, there is still more than enough conversion gain – 6 to 15 dB, depending on frequency. Although it is possible to design oscillators using single- or dual-gate MOSFETs, there is nothing to be gained from the additional complexity and expense, compared to a well-designed JFET or bipolar oscillator. Of the circuits shown in Fig. 3, I have found the JFET to be the easier of the two crystal controlled circuits to get working. It seems a bit more predictable and stable than the bipolar model. A pleasant surprise was the very simple JFET vfo. It is rock stable, and the output is very clean. It is recommended for any use where a tunable front end is required, up to about 220 MHz.

Note that the output of the crystal oscillators has to be tapped down on the tank coil to keep the injection voltage down to the desired level. Component values for a variety of i-fs will be found in Table IV

Construction Notes

Use of a shield between the input and output coils of the rf amps is imperative.

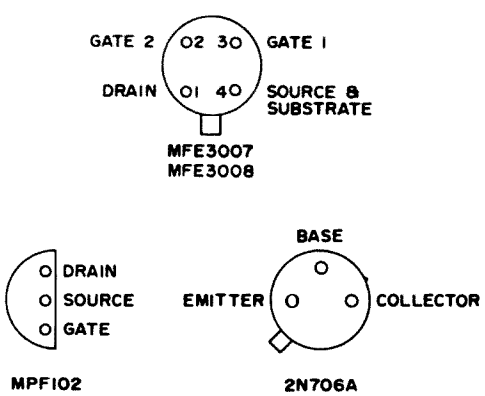


Fig. 7. Base diagrams of transistors referred to in schematics and text (bottom views).

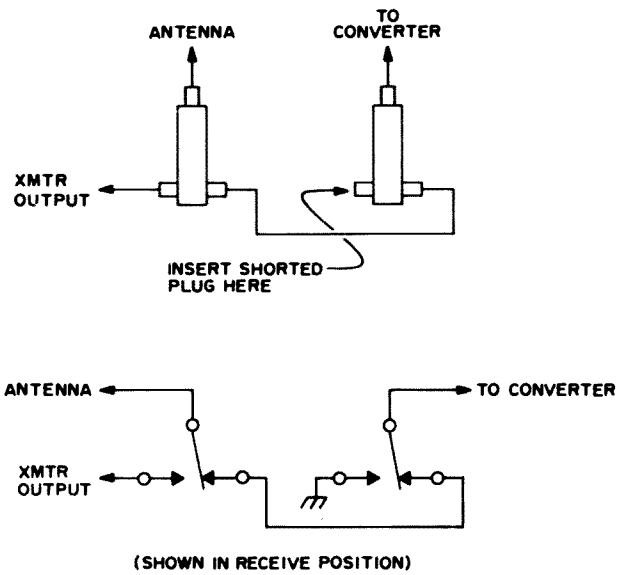


Fig. 8. Method of connecting antenna relays in series to protect MOSFET front end.

Feedtrhough capacitors are definitely recommended for everything going in or coming out (except, of course, for the signal connections). They will help eliminate another potential source of rf leakage, and instability. See the diagrams of various convertors, Figs. 4–8. Mechanical stability and sound shielding techniques must be observed to derive maximum benefit from the circuits presented here. Printed circuit techniques are not recommended because of rf leakage potential. Use copper clad board as a chassis, and enclose the bottom with an appropriate off-the-shelf chassis, in time-honored VHF homebrew tradition.

With these building blocks, and reasonable care, any moderately experienced homebrewer can put together converters which will truly approach state-of-the-art performance. The only empirical fiddling which will be necessary will be that required to maximize the signal-to-noise ratio in the first tuned circuit. Right now, I should warn you that some of my tuned circuit values are computed, while others are proven in performance. They should be right on the money, but if you have to do a little trimming here and there to get things to peak up, don't be upset with me. A few hours spent working with these building block circuits will pay off in unexcelled VHF reception.

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$15 T-POWER SUPPLY

Interest in amateur mobile communications has recently been stimulated with the increasing availability of retired commercial FM equipment. For many years the workhorse of the mobile power supply has been the mechanical vibrator. Semiconductors that are capable of handling the same task with increased efficiency and dependability are available commercially. All preliminary design goals were exceeded in operation of this solid state vibrator replacement.

The necessary prerequisites were:

- Simple design with low construction cost
- Minimal modification of existing equipment
- Operational dependability regardless of ambient temperature extremes
- Reduction of conventional T-power noise on transmitted signal

Although direct application is made to the General Electric 30 Watt Progress Line, with no circuit changes the same device may be used with comparable vibrator powered equipment.

Construction

The basic circuit is a two transistor push-pull inverter (Fig. 1).

Any toroid with a suitable feedback winding for the transistors in use and a secondary section capable of 250V at 70W may be used for (T1). (R1) the starting resistor will supply a minimum of 0.6V on the feedback winding centertap for a supply voltage of 12.6V. This will insure dependable transistor starting with the low ambient temperatures that are encountered in mobile operation.

The Motorola HEP 233 power transistor's maximum ratings include a 30% safety margin on the collector-to-base voltage (Vcb)

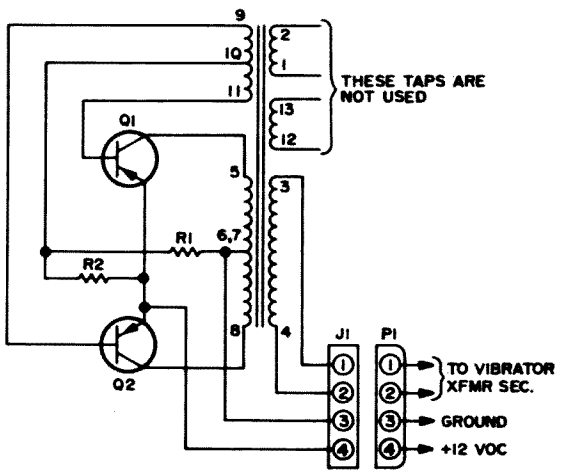


Fig. 1. Schematic diagram of T-power. R1 @ 200Ω, 10W; R2 = 10Ω, 10W; Q1, Q2 = Motorola HEP 233; T1 = Toroid T-2, $2.95 Tower Communications[1]; P1 = Cinch-Jones 4-terminal connector.

and collector current (IC) parameters. The HEP 231 power transistor may be used with increased savings in construction cost. However, this transistor should not be used in circuits requiring input power in excess of 70W. (Q1) and (Q2) are mounted on heatsinks and it is imperative that the TO-36 transistor case, the transistor's collector, be insulated from the chassis. A HEP 455 mounting kit provides insulation and maintains adequate heat transfer properties from the transistor to the heatsink.

The heatsinks are mounted on a 5x3x2 in. aluminum minibox. A chassis mounted 4-conductor Cinch-Jones receptacle provides input power for the inverter and transfers output voltage from the toroid secondary to the mobile power supply. The toroid transformer and associated components are mounted within the minibox. Several drops of epoxy cement secure the toroid to the

[1] *Tower Communications, 1220--22 Villa St., Racine WI 53403.*

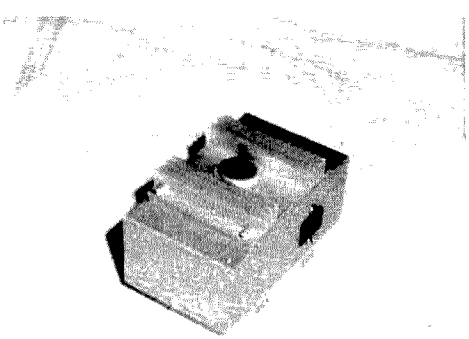
chassis. Any method may be used to secure the transformer provided the securing elements are of non-metallic composition. All connections to the individual transformer terminals are made with the assistance of a diagram supplied by Tower Communications with each purchase. Insulated 16-gage wire or larger is recommended for all connections.

Addition to Mobile Power Supply

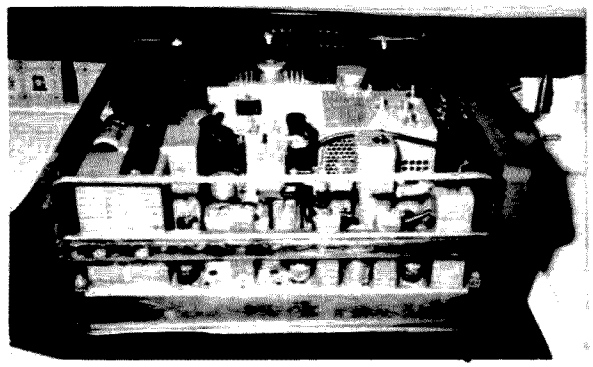
An ohmmeter is used to test the vibrator equipment prior to attachment to the mobile supply. Resistance measurements across the 12V input terminals indicate a 10Ω forward and 50Ω reverse resistance. Under no-load conditions, the inverter output voltage is about 285V.

By connecting the inverter output to a selected secondary winding of the vibrator transformer, existing relay functions and rectifying components of the original mobile supply are used. The desired secondary winding is located by measuring the output voltage from combinations of secondary transformer taps while the receiver operates from the vibrator supply. The combination, which develops 250V under receive load conditions, will function as an input terminal for the inverter output. The (BLACK-RED) and (RED-GREEN) windings are used with the General Electric Progresss Line 30 Watt vibrator supply.

The 12V inverter input voltage is obtained from an appropriate terminal on the battery input socket. Terminals 4 and 1 at connector (J501) are used with the General Electric power supply. The inverter unit may be mounted on the front panel of the transceiver basket or on the power supply chassis. The final modification prior to operation is removal of the vibrator from its socket.



Top view of unit shows large heat dissipation area provided by heatsink.



T-power unit fits snugly between power transformer and relay on Progress Line power supply strip.

Summary

Installation of the T-powered vibrator replacement requires that the transmitter be retuned. Units using this power supply modification experience an input power increase of about 30%. Thus a heavy duty replacement for the final amplifier tube is recommended (i.e. 8298A or 6146W for the 6146A). Receiver B+ decreases about 10%. This slight loss extends the life of audio output tubes such as the 6AQ5 and does not impair receiver operation.

Examination of an unmodulated transmitter signal indicates little or no discernible audio distortion such as "T-power whine." The "whine" is filtered by choking action in the secondary winding of the vibrator transformer.

A significant improvement in the ambient noise figure of the receiver is noted with the T-power. Increased audio clarity on weak signal reception is very noticeable.

The T-power circuit described has been in use at my mobile station for over six months. Dependable service and improved equipment operation make this circuit a mandatory addition to any mobile installation.

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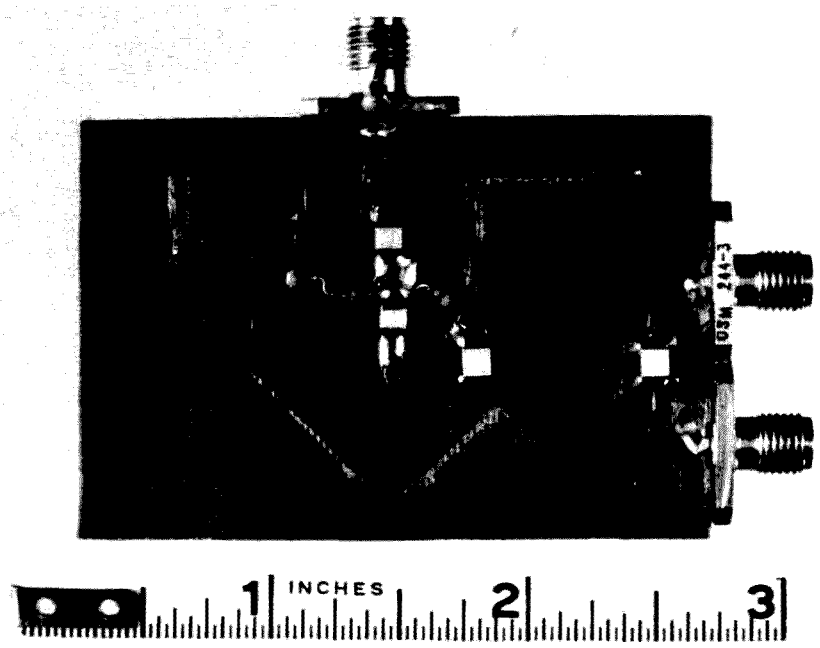
References

General Electric Progress Line Manual 144-174 MHz, 12V, Transistor Powered Mobile Combination FT-36 and MT-36.

Radio Corporation of America, *Power Circuits DC to Microwave*, 1969, pp. 162–199.

Tower Communications, data sheet supplied with toroid transformer T-2.

Kurt Bittmann, WB2YVY
147 McGaw Ave.
ereach, N.Y., 11720



EASY-TO-MAKE 1296 MHz MIXER yielding a 6.5 dB noise figure

Microwaves are for the birds. You have to go out of the way with equipment to accomplish what is eaqual to a 10¢ phone call. That is how I thought about it for years. But then I saw microwave walkie-talkies with built-in spiral antennas for Astronauts – that turned me on. Microwaves are great for space as you know. Low power communications are made over long distances and small physical antennas with high gain can be used. The future of these frequencies looks bright in every way. There are hams in the Arctic, airplanes, ships and soon I'll bet in space. And you cannot call for 10¢ to Mars. Besides, every ham cannot buy microwave equipment from the shelf.

So I needed a mixer to start with. The ones I had seen so far did not appeal to me. You could hang a diode on an antenna with a local oscillator and have a mixer, but it should be at its best. To be just that, you need the following:

1. Low noise microwave diodes
2. Good impedance match
3. Get the signal to the diodes and not into the oscillator circuit.
4. Get the local oscillator signal to the diodes and out of the antenna.

To accomplish these points I used:

1. Microwave Associates MA 4882 Schottky Barrier Diodes
2. L4, L5 are a bit shorter than a quarter

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Audio output .....500 mw
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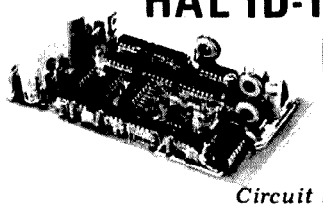
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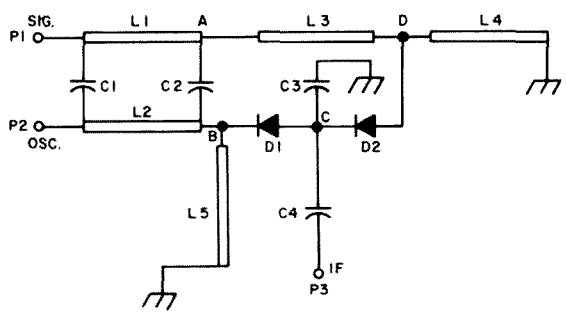


Fig. 1. Schematic. L1 – λ/8 50Ω micro strip line .176" wide, .755" long; L2 – λ/8 50Ω micro strip line, .176' wide, .755" long; L3 – λ/4 50Ω micro strip line .176" wide, 1.51" long: L4,5 – λ/4 micro strip line .050" wide 1.170" long; C1, C2 – 2.3 pF ± 0.1 pF Pellets 0.1" x 0.1"; D1, D2 – MA 4882 Microwave Associates; C3 15 – pF Pellet C4 – 100 pF. Dimension only good for a board with a dielectric constant of 2.5, two sides copper, 0.062" thick. The shape of L1, L2 is such that minimum coupling occurs. Capacitors from American Technical Ceramics, 1 Norden Lane, Huntington Station N.Y. 11746 were used. Order numbers are: C1, C2 – ATC 100 B2R3CP; C3 – ATC 100 B 150MP; C4 – ATC 100 B101MP.

wave, so besides the dc return path they are slightly capacitive to cancel out inductance

3. L1, L2, C1, C2 is a 3 dB 90° coupler. Power coming in Port 1 will be split between A and B with 90° phase difference. It is theoretically possible to have over 40 dB isolation between P1 and P2.

Through the λ/4 line of L3, 90° phase shift is added and any signal coming in will be split and 180° out of phase between D and B. So signal oscillator and dc should be balanced out at point C leaving only the difference at Port 3. C3 will ground any remaining signal and oscillator rf after mixing. C4 is a dc block for the i-f.

The coupler alone, (see Fig. 2) was made first to measure its performance. In the final mixer version it is hard to do that, especially after the diodes are in. They will multiply any signal and reflect these harmonics. Then I went to Fig. 3, soldered the components in and was surprised how well it worked. Watch for the distance of C1, C2 (see Fig. 3). As a substrate, double copper clad teflon fiberglass was used. To follow dimensions of Fig. 3 it must be 0.062" thick with a dielectric

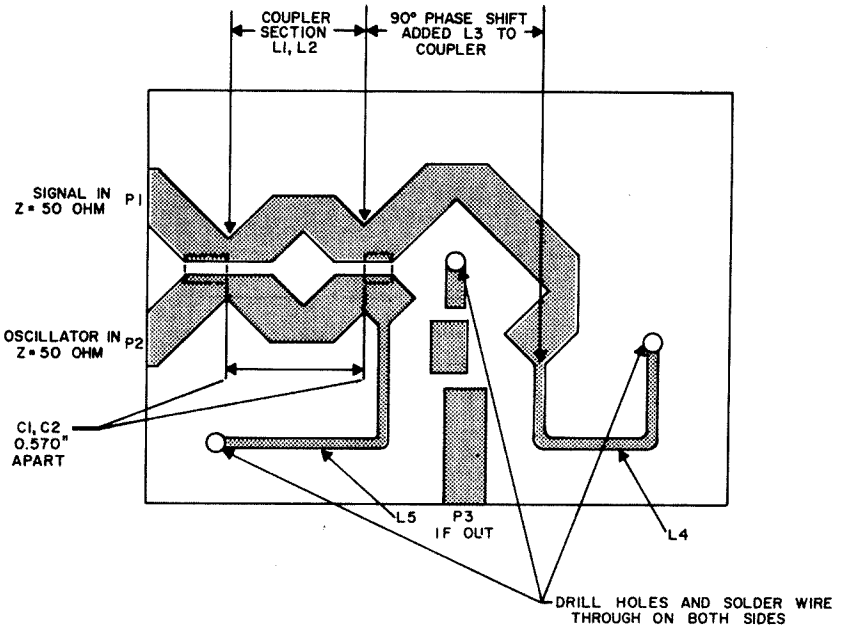


Fig. 3. Printed circuit board layout.

constant of 2.5, such as for teflon fiberglass. Photo etching would have been perfect, but not feasible, so both sides of the board were taped. The back side of the copper is needed as a ground plane. Then a drawing as in Fig. 3 was glued over it and cut out with a razor blade; the paper and tape where no copper should be was peeled off. After etching I drilled the three ground holes, stuck wire through and soldered it on both sides. As connectors I used OSM 244-3 with the mount soldered to the bottom foil.

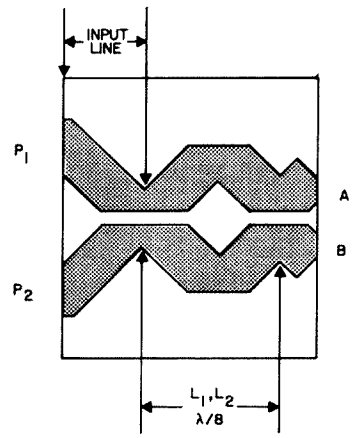


Fig. 2A. Board layout.

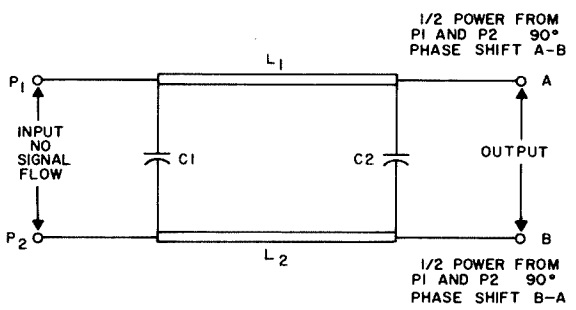


Fig. 2B. Schematic.

If you are not familiar with micro strip let's talk about it first, since the whole layout is based on it. It is similar to coaxial transmission line. Let's take L1, Fig. 2 – it consists of a .176" wide .755" long strip and a ground plane on the other side with a dielectric of 2.5 in between. The result is a $\lambda/8$ long 50Ω line. If it is made wider or the dielectric constant is higher the characteristic impedance will go down. Most of the electrical fields are contained between strip and gound plane. L1 and L2 are shaped in such a way that minimum coupling occurs.

Being fairly accurate with dimensions, this mixer should work very well. The lowest noise figure I got was with 2.8 mW local oscillator signal 60 MHz below 1296 MHz. An H-P noise meter with an i-f noise figure of 2.5 dB was used for the measurements, so that the actual mixer noise is even below 6.5 dB. Commercially available mixers with that noise figure will typically cost about $100.

I'd like to thank Raymond Camisa and Wheeler Laboratories for helping me complete the mixer. . . .WB2YVY

John J. Schultz, W2EEY
1829 Cornelia St.
Brooklyn, N.Y. 11227

VHF REPEATERS IN EUROPE

A status report with some vacation planning tips.

The rapid growth of repeaters in Europe and the fact that temporary operating licenses can be obtained by U.S. amateurs in many European countries opens the way for the U S. amateur visiting Europe to enjoy VHF FM operation. The advantages of such operation as compared to carrying along HF gear are many. First of all, the equipment itself that is required is relatively simple. Any number of the commercially available or home-built transceivers that are battery operated and deliver 1–2 watts output will fit in a suitcase and will suffice for most repeater operation. Antenna requirements are simple and a simple whip antenna can be used or a portable beam be made of wire elements for indoor use which also will easily slip into a suitcase. But, the greatest advantage of VHF FM operation in Europe is probably the contact that it allows with local amateurs. As in the U.S., the operators that use most repeaters in any given city pretty well get to know each other through repeated QSO's and the QSO's tend to get somewhat "stale" at times. A new station and particularly one speaking English and using a special temporary call sign will usually find a special welcome on a repeater channel that is far more pleasant than that experienced on HF (more on operating habits and courtesy later). Last, but not least, one may be able to operate 2 meter FM in Europe although one has less than a General Class license and therefore could normally not secure a reciprocal license.

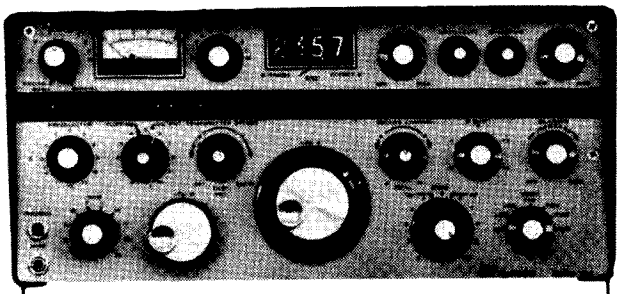
Licensing

The material in this article is mainly directed at the amateur visiting Germany, Austria or Switzerland since the repeater possibilities are the most developed in these countries. All repeaters in these countries are also available to any amateur to use (private repeaters are basically not allowed). Germany, particularly, has a large and developing repeater network throughout the country. Many other countries plan repeater networks, such as England, but do not have repeaters yet in operation because of technical approval and details that remain unresolved with their administrations. The latter is unfortunate for the visitor since 2 meters as such is a popular band in England and a number of beacon transmitters are in operation. As a matter of interest, there are some 60 VHF beacons operating in Europe in-

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cluding 40 on the 2 meter band and 11 on the 432 MHz band. However, before any operation can be undertaken one must, of course, secure the necessary temporary operating license on the basis of one's U.S. operators license. Given below are the addresses to write to in order to secure the necessary application forms. A photostat of one's U S. license is required and a small fee of a few dollars. Be sure to fill out the application form as directed and also to take care of the licensing arrangements a few months ahead of time. In most cases the amateurs who handle the details of securing the reciprocal licenses from the necessary authorities in their countries do so on a volunteer basis and one should attempt to help them as much as possible. Try to remit the necessary fees in the amount required in their currency rather than sending a simple personal dollar check which requires that they go through an extra effort to have the currency converted. The service that is provided is usually very fast and efficient. For instance, the last time I applied for a temporary license in Germany, it took only about 2 weeks to complete the whole transaction. A license was received authenticated by the necessary Post Department authorities (a branch of the Post Office Department acts as the equivalent of the FCC in almost all European countries) and it was complete with a detailed booklet, in English, which explained the operating regulations, power limits, etc. Be sure to indicate that operation only on VHF will be undertaken if one has only a Novice or Technician Class license.

For Germany write to:

Deutscher Amateur Radio Club
International Affairs
Muehlenstr. 27
5601 Doenberg /Wuppertal, Germany

For Austria write to:

OVSV Dachverband
Attn: OE1WN
P.O. Box 999
1014 Vienna 1, Austria

For Switzerland write to:
Generaldirektion der PTT
Sektion Allgemeine Radioangelegenheiten
3000 Berne, Switzerland

Equipment to Use

This section covers the frequency channels in use but a word about the FM equipment in use in Europe might first be in order. In general, one will find that 2 meter FM has generally gone down the same equipment development phases in Europe as in the U.S. Much of the initial 2 meter FM work, particularly mobile, was done using FM equipment converted from commercial surplus. Instead of names like Motorola or GE, many amateurs will report that they are using Siemens, Telefunken or Storno equipment. The power levels in use tend to be somewhat lower than in the U.S. with mobile installations rarely exceeding the 25 watt output level. Repeater installations also tend to be low-powered and often the Postal authorities limit the repeater power levels to 15 watts output. Today, the amateur sales market in Europe is in full bloom with Japanese made equipment. Almost all of the brands sold in the States (and some not yet sold in the States) are available, although sometimes under different brand names depending upon which company has picked up the distribution rights from the original Japanese manufacturer. For instance, the Drake TR-22 is sold under the original manufacturer's name as the Trio TR-2200. The Tempo line is sold under the Yaesu or Sommerkamp labels, etc. But the imported equipment is basically the same as that sold in the mp labels, etc. But the imported equipment is basically the same as that sold in the U.S. although it may be a bit confusing at first when one describes his station in a QSO and finds that in spite of different names, the equipment is the same.

A price comparison for imported equipment of a similar nature in Europe and the U.S. is difficult because of the accessory items that are sold in some cases as part of the equipment and in other cases as extras. German distributors tend to market the Japanese equipment exactly as it is packaged for use on the Japanese market. That is, with a few standard Japanese channel crystals installed (useless in both Europe and the U.S.) and with the original Japanese equipment manual perhaps supplemented by a very brief translation of the most important circuit features. For this reason, one may find Japanese equipment costing a few dollars less in Europe, but the difference is not significant.[1]

Nonetheless, one may want to consider purchasing some VHF equipment in Europe. There are the advantages that one doesn't have to worry about transporting the equipment and going through customs. The equipment can also be ordered with crystals installed and tuned up for use on the main European repeater channels. One may also be able to work out a purchase-repurchase arrangement with an equipment dealer, since the FM equipment market is strong for both new and used gear, so one would in effect be renting the gear. One would have to work out these arrangements on an individual basis. The place to start would be to write for a brochure on the VHF FM equipment available to some of the larger dealers in amateur equipment, such as:

Hannes Bauer Company
P.O. Box 2387
Bamberg, Germany

or

Richter Company
Grabben Strasse 9
Hannover, Germany

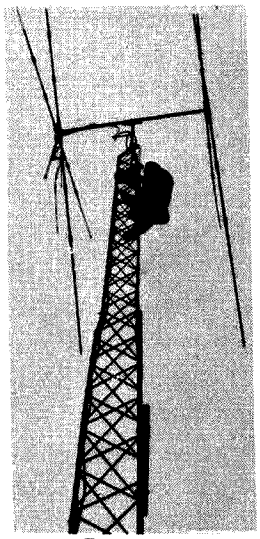
Both of these companies also provide full-size catalogs of all of their amateur gear, but the cost of each catalog is $2.50.

Tone signaling is not yet used on most repeaters, except in Switzerland. If it is used (indicated in next section), a standard tone frequency of 1750 Hz is used. Only one or two repeaters, such as the Berlin one, use complicated entry signals which generally would not be useful for the visiting amateur to provide for. The definite trend on 2 meters is towards repeater entry via a 1750 Hz tone, although for the next year or so

[1]These radios are often redesigned in order to meet FCC specifications for emission. Tests at the 73 labs have confirmed that the difference is substantial – Ed.

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one will be able to use most repeaters without any tone entry. If one already has a tone generator built into a 2 meter FM transceiver, it would be a good idea to reset it for 1750 Hz if its present frequency is much more than 50 Hz removed from this frequency.

Repeater Channels in Use

The installation of repeaters in Europe is growing rapidly and in some countries, particularly Germany, one can find a repeater to enter from practically any corner of the country. This rapid growth of repeaters has brought with it the usual problems of channel spacing and overlaps in coverage so repeater frequencies are subject to change. Nonetheless, the repeater frequencies shown here should certainly be useful throughout 1972.

As one reviews and studies the development of 2 meter FM repeater installations in various countries of the world, a rather sad picture emerges about amateur radio. Repeater channels in most countries were chosen on the basis of the channel spacings common for commercial surplus FM equipment. But for a hobby that is supposed to be as "international" as amateur radio and with all the international cooperation that is supposed to exist among the amateur organizations, one would think that as 2 meter FM enters its second generation that some order would be agreed upon for at least the main repeater frequencies. Instead, if one looks at the Japanese FM channels, the U.S. channels and the European channels, they are all different and what is perhaps worse, the planning that goes on for future repeater channels will keep them all different. Even the so-called "calling frequencies" in each country are different. This is all in spite of the fact that aside from some small exceptions, the first 2 MHz of the 2 meter band is designated for amateur usage in Regions I, II and III of the world by the ITU.

Germany

Germany has two major calling frequencies designated. One is 145.000 MHz and the other 145.150 MHz. Unfortunately, the latter frequency corresponds to one of the repeater frequencies and if one wanted to

equip a transceiver for a simplex channel, 145.000 MHz would be the better and more common choice. However, a calling frequency channel is not necessary and for a low-powered transceiver may prove fairly useless. After all, if one is using a 1 watt transceiver with a simple whip antenna only slightly above ground level or in a city hotel room, one might as well walk the short distance covered via a direct channel.

Repeaters cannot be freely put into operation in Germany and a great effort has been made to develop an overall frequency plan for repeaters. Basically, a special permit is required from the German equivalent of the FCC to erect a repeater and this permit will not be granted unless the German Amateur Radio Club (equivalent of ARRL) first approves the repeater proposal as being compatible within the existing system. Repeaters can have a maximum power output of 15 watts and a deviation of ±5 kHz. Vertical polarization is used and the repeater identifies itself at least every ten minutes by F2. At the present time, a tone signal is not used to open most repeaters, but the definite trend is to use a 1750 Hz tone to open the repeater. At the moment, there are four repeater channels designated:

Channel	Transmit to Enter	Receive On
1	144.150	145.750
2	144.200	145.800
3	144.250	145.850
4	144.300	145.700

These channels with 50 kHz spacing were arranged on the basis of the 50 kHz channel spacing formerly used by commercial FM gear. A plan has been started by the German Radio Club to convert to 25 kHz channel spacing and to create 3 more standard repeater channel. If one is planning on visiting specific cities, one can search out the channels necessary. For general travel, it is obvious that equipping a transceiver for the new channels 2, 4 and 6 will provide the broadest coverage. There are two repeaters that operate on non-standard frequencies, probably because of their partial coverage into East Germany so East German stations can also be contacted. One is the Berlin repeater DLØSB (transmit on 145.150, receive on 145.600). A tone sending the number 6 opens the relay. The other is the Elm mountain repeater (transmit on 144.800, receive on 145.900). The following are the standard channels and repeater locations in Germany:

Channel	Transmit to Enter	Receive On
2	144.150	145.750
3	144.175	145.775
4	144.200	145.800
5	144.225	145.825
6	144.250	145.850
7	144.275	145.725
8	144.300	145.700

Channel	Call Sign	Location	Licensee
2	DBØWF	Berlin (radio tower)	DL7OG
2	–	Cham	DC6YC
2	DBØXA	Coburg	DJ7WH
2	DBØWW	Duisburg	DC6WR
2	–	Feldberg (Rhein – Main)	DC8VC
2	DBØXH	Hamburg	DL6FX
2	DBØWH	Hannover	DJ1UY
2	DBØZF	Kaiserstuhl (Freiburg)	DJ8PK
2	–	Kassel	DJ1XJ
2	DBØWK	Konstanz	DK1MW
2	DBØWL	Lahr (later channel 6)	DL9QD
2	DBØZM	Munich-City (later channel 6)	DK5MZ
2	DBØZN	Nuerberg	DK2YV2
2	DBØZØ	Osnabrueck	DJ7ZS
2	DBØWR	Stuttgart	DK4SU
2	DBØWB	Winterberg (Au/Inn)	DC1MT
3	–	Bad Koenig	DL2WN
3	–	Bocksberg (Harz)	DJ3JW
3	DBØWG	Goeppingen	DJ4LY
4	DBØWA	Aachen	DL6IM
4	DBØXB	Baederstrasse (Baltic Sea)	DK6HD
4	–	Bamberg	DC1NY
4	–	Bentheim-Lingen	–
4	DBØWC	Bremerhaven	DC8FD
4	–	Darmstadt	DC6FG
4	–	Deggendorf	DJ3SF
4	DBØWD	Deisier	DJ6JC
4	DBØZR	Dortmund	DJ4VR
4	DBØXR	Dreilaendereck (Loerrach)	DJ4Q4
4	DBØZZ	Grab*	DL8XY
4	DBØXG	Greding	DL8ZY
4	–	Hersefeld	DK2RH
4	DBØYK	Homberg-Kaiserslautern	DC8DY
4	–	Koblenz	DK4PW
4	–	Leer/Ostfriesland	DJ9ZW
4	–	Lindau-Northeim (Hannover)	DL9AD
4	DBØZL	Luechow/Elbe	DC8XT
4	DBØWS	Siegen	DL8KV
4	DBØWX	Triberg	DJ8MY
4	DBØZW	Weiden	DJ9HO
5	–	Hoher Meissner	DC6EE
5	DBØWN	Ochsenwang	DJ2GO
6	–	Andernach-Mayen	DJ5GU
6	DBØZA	Aschberg (Rendsburg)	DC8C8
6	–	Bremen	DC6CA
6	DBØWT	Detmold	DK3RC
6	DBØWE	Essen	DJ1HT
6	DBØWS	Goslar-Steinberg	DJ4JI
6	DBØZH	Heidelberg	DL1LS
6	DBØYH	Hoechenschwand (Black Forest)	DJ9ZK
6	DBØWV	Hoechsten	DJ3CH
6	–	Koeln-Bergheim	DJ3RD
6	–	Knuell	DL8MC
6	DBØXS	Merzig/Saar	DK1MG
6	DBØWM	Muenster/Westf.	DC6EH
6	DBØZB	Ochsenkopf	DJ7EW
6	DBØWZ	Wuerzburg	DK2DT
7	DBØZU	Zugspitze (currently ch.6)	DJ9HJ
8	DBØXA	Altenwalde	DJ9CR
8	–	Kalmit	DL8UX
8	DBØYY	Ludwigsburg (later channel 3)	DJ4XO

*5 second tone to enter.

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Austria

Austria has generally followed the same philosophy in developing a 2 meter repeater network as in Germany. The Austrian system is not as yet developed as the German one but progress is being made. Many Austrian amateurs who live near the German borders using the German repeaters, along with the relatively low amateur population may account for the lack of development of a repeater network in Austria. The channels used in Austria are the same as those used in Germany so refer to the German channel frequency listing for the following Austrian repeaters:

Channel	Call Sign	Location
1	OE5XGL	Altmuenster
2	OE5XUL	St. Johann
2	OE7XTI	Innsbruck

The above repeaters are in operation presently. In addition two other repeaters, one in the OE3 and one in the OE6 sector of Austria, should be in operation later in the year. No details are available on these latter repeaters as yet but they will most likely use the same channel as the above repeaters.

Switzerland

2 meter repeaters are not allowed by the postal authorities in Switzerland but they are allowed in the 432 MHz band. Amateurs there have therefore turned to developing a network of 432 MHz repeaters. Two standard channels are used:

Channel	Transmit to Enter	Receive On
1	431.050	438.920
2	431.200	438.800

The repeaters in use are:

Channel	Canton	Entry Tone Frequency
1	Zuerich	1160 Hz
1	Luzern	1595
1	Fribourg	1290
2	Luzern	1160
2	Solothurn	1160
2	Appenzell	1595

The tone call is necessary to open the repeaters. The repeater frequencies are compatible with the 432 MHz repeaters in Germany although there are only two such/latter repeaters in use, one in Frankfurt using channel 1 and one in Giessen using channel 2.

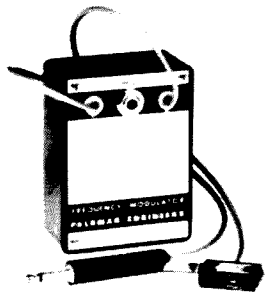
Operating Habits

As was mentioned before, foreigners will find a nice welcome on VHF FM but the way to start is not by breaking up a QSO that is taking place. Take the time to listen first to see what the operating practices are like. Most amateurs will try to keep their QSO's over repeaters relatively short and will particularly try to give preference to mobile stations calling in. Even in spite of the language problem, it is relatively easy to learn to recognize when the repeater is free. Then a short QRZ in English can be called. Often, one will fine many stations eager to have a QSO in English and perhaps sometimes too many. If one finds too many stations lining up for a QSO it would be a good idea to go QRT for a while rather than monopolize the repeater. After all, it is their repeater. Most stations will be glad to exchange QSL cards if desired although one sometimes hears the comment that repeater QSO's aren't really direct QSO's and therefore don't deserve QSL's. Phone-patching is not done so don't bother to ask for it.

Antennas

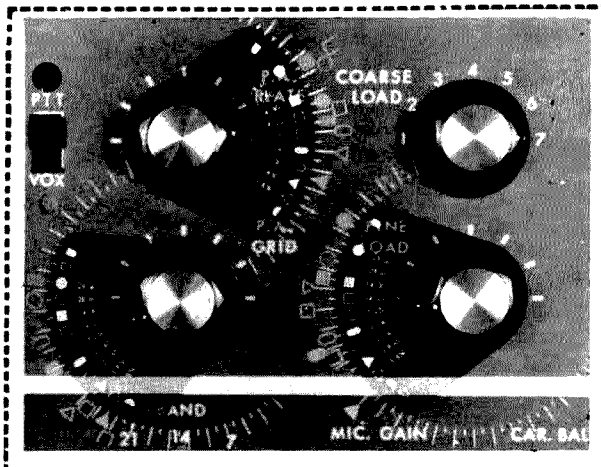
Taking a small transceiver along on a vacation trip can generate some antenna problems. A simple whip antenna such as that built into some transceivers will work fine in a good high QTH but normally supplementing it with a better antenna will prove worthwhile. One of the simplest antennas to use is a folded dipole cut to frequency much like an indoor FM dipole. A small balun of the type used for broadband FM-TB 300 Ω to 75Ω conversion will handle 1 – 2 watts and can be mounted at the transceiver so twinlead can be used to the folded dipole which is also constructed from twinlead. The advantage to this type of antenna is that it can be moved around in a room for the best results while the transceiver remains stationary. The antenna can be fastened to a window with tape. The dimensions for such an antenna for 2 meters are shown in Fig. 1A. If one wants to get just a bit more elaborate, a portable beam can be constructed using the rods formed from metal clothes hangers and a few banana jacks and plugs. By choosing the antenna

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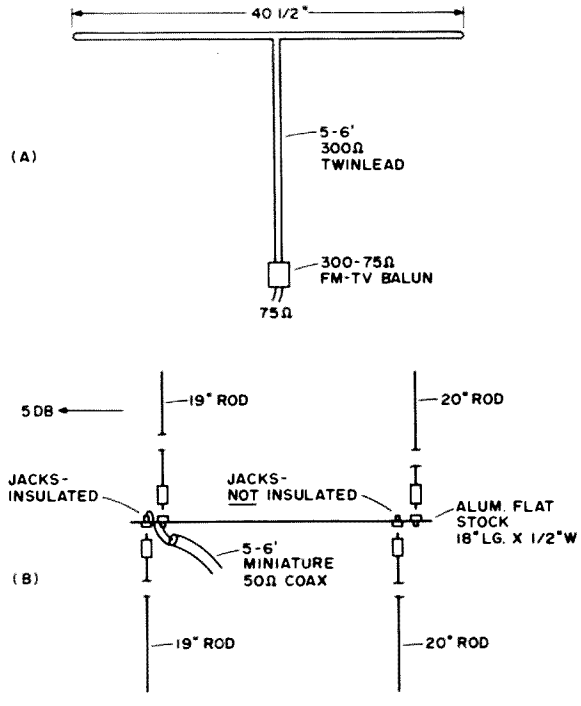


Fig. 1. Two simple antennas for 2 meters.

dimensions properly, as shown in Fig. 1B, the driven element will directly match a coaxial cable feed. The whole antenna just plugs together in a matter of seconds and can be easily transported. In use it can be supported from a piece of furniture, taped on a window, etc. The 5 dB of gain provided will easily make the difference at times between being able to activate a repeater and not being able to do so, as I have often experienced when using a TR-22 and the antenna inside a room. Use miniature coaxial cable to feed the antenna such as RG174 or RG178. The difference in attenuation between these cables and RG58 or RG59 for lengths of 5 - 6 feet at 2 meters is not significant and the miniature cables can be handled conveniently like hook-up wire.

. . . W2EEY

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Glen E. Zook K9STH
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LOW COST THICK FILM RF PREAMP

This article presents a low cost rf preamplifier most economically expressed in thick film technology. Input and output impedances are 50Ω to match conventional transmission lines. The tuned circuits are preset during manufacture but may be repeaked when the preamp is installed. The entire unit is injection molded to produce a waterproof, virtually indestructible product.

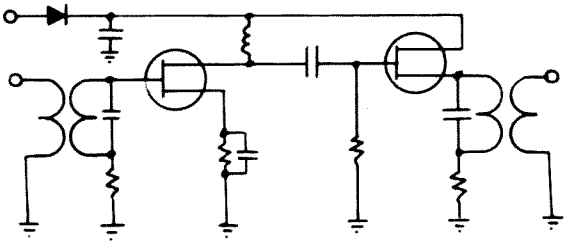
The basic preamp circuit may be referred to as a "handbook circuit." It consists of a 2N5245 N channel FET as the rf amplifier with a second 2N5245 as a source-follower. The purpose of the source-follower is to isolate the rf amplifier from the remainder of the receiver circuitry and thus prevent oscillation. Chip resistors and capacitors have been utilized with discrete transistors. Later improvements will include chip semiconductors.

The original design utilized fixed inductance and close tolerance NPO capacitors. However, this method was not conducive to high volume production. Also, such a system allowed no compensation for outside circuit parameters. Thus, the revised design incorporates slug tuned coils.

It was originally planned to make the unit field serviceable. However, most field service stations are not equipped to handle hybrid circuit repairs. Also, the low initial cost of the hybrid circuit makes replacement rather than repair more economical. The final design consists of an injection molded package with provisions for alignment of the slug tuned coils. The rf input, rf output and power cables are all internally connected before molding. The injection molding produces a waterproof, virtually physically indestructible package.

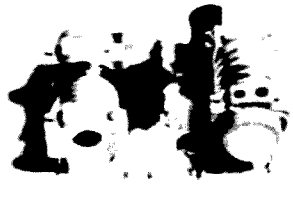
Protective Circuitry

The amount of protective circuitry depends upon the application. All units incorporate reverse polarity protection in the



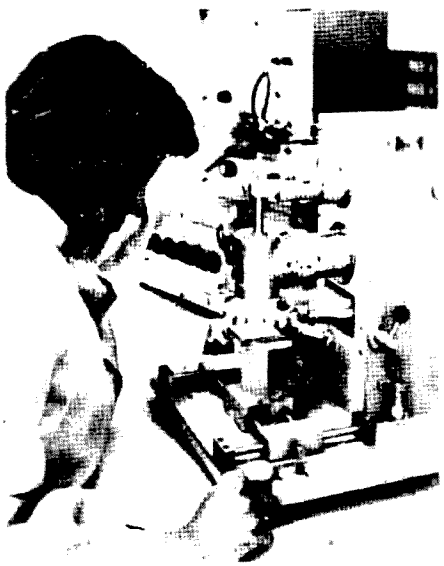
1. Basic Schematic

Fig. 1. Basic schematic.

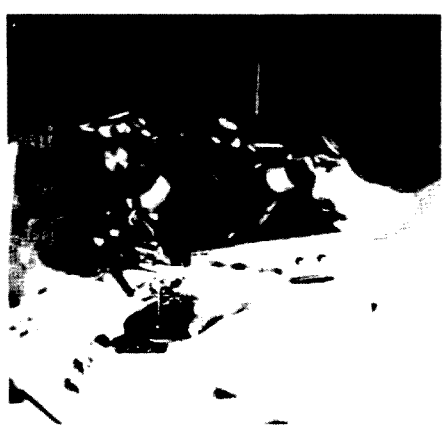


Interior view of preamp.

form of a silicon diode (1N4001). In applications involving medium and high power transmitters in close proximity to the preamp, germanium diodes are placed across the input to protect the field effect transistors. In low power applications such as CB where power output is restricted to 3.5W or less, the diode protection of the FET's is not needed. For special applications, the entire circuit may be shielded.



Assembly operations.



Applications

The hybrid preamp was originally designed for use in CB equipment (27 MHz). The original application is as an "add-on" accessory to the receiver portion of the unit. Other applications include incorporation of the hybrid circuit as the receiver "front end" in new design equipment and in receivers for radio controlled equipment.

This hybrid concept may be expanded to include thick film rf preamps for other services. These include low band FM (25–50 MHz), 6 meter amateur (50–54 MHz), special single channel television requirements (54–88 MHz and 172–220 MHz), FM broadcast (88–108 MHz), aircraft (108–132 MHz), high band FM and 2m amateur (132–172 MHz). Other possibilities include UHF FM communications (450–470 MHz), industrial radio control (72-76 MHz), and other VHF and UHF radio services.



Fabrication area.

Construction

The construction begins with a 0.015 in. ceramic substrate. On this is screened a paladium-gold conductor pattern. The substrate is then fired at 900C. After firing, the substrate is inspected and passed to the assembly department. Assembly begins with the soldering of the chip components, progresses through mounting of the discrete active components, and finally to the mounting of the rf coils and external connection leads. The unit is then visually inspected.

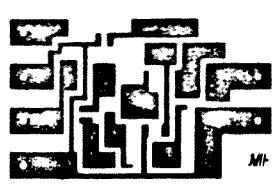


Fig. 2. Substrate conductor pattern.

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Initial Testing

After completion of assembly, the unit is given an initial electrical test and rf alignment. This stage consists of the application of the required 12V dc to the unit and checking for dc parameters including excessive current and open circuits. The initial rf alignment is as follows: A signal at the desired frequency is applied to the input of the hybrid circuit through a 50Ω pad. The output of the hybrid is connected through a second 50Ω pad to an indicator. Power is then applied and the slug tuned coils peaked. The total gain of the preamp is measured and if within specifications, it proceeds to the next stage, encapsulation. If the hybrid circuit fails, it is sent to a repair station for troubleshooting. After repair it again is visually inspected and undergoes a second complete electrical and rf test.

Encapsulation

The final manufacturing stage consists of encapsulating the entire circuit through injection molding techniques. Teflon rods are inserted into the slug tuned coils to form holes in the encapsulation material to allow alignment after the unit is installed. After encapsulation, only the three cables (rf in, rf out, and power) and the holes for alignment are visible.

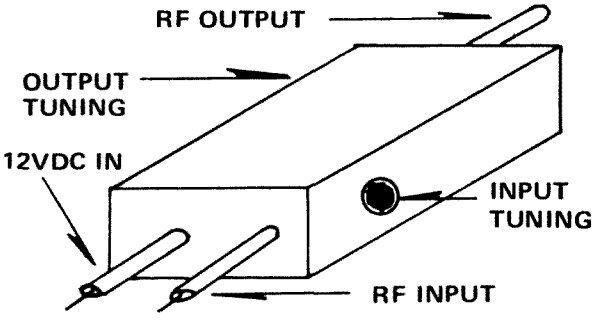


Fig. 3. Final package.

Final Testing

After encapsulation the unit is given a final electrical and rf test. Because of the encapsulation material, it is necessary to slightly realign the tuned circuits. If the unit is rejected, it must be discarded. Accepted units are labeled and serially numbered.

. . .K9STH

PICTURE PAGE



ABOUT 8,000,000 CONTEST POINTS

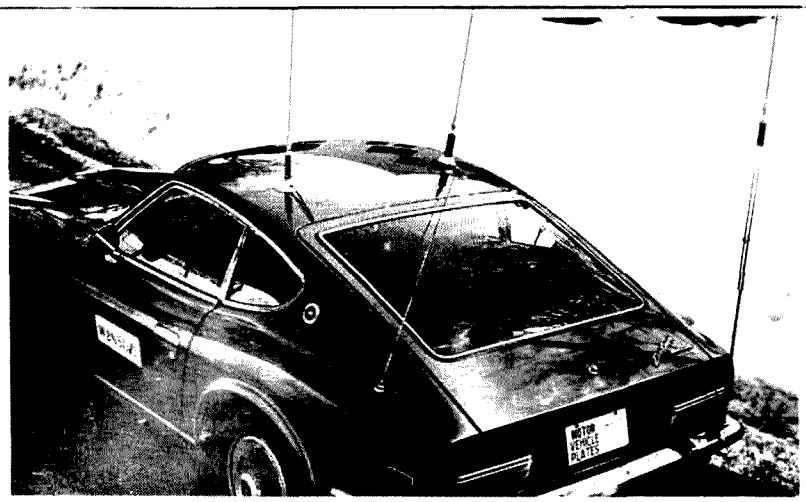
On a recent visit to Washington Wayne visited the Potomac Valley Radio Club and snapped this candid picture. These are the big guns of the east coast — they were adding up their cumulative score for the DX contest and it staggered the mind. Was it 8 million, 12 million or 15 million points? Whatever it was, they sure must have beat out their perennial rivals up in Philadelphia. This group has worked everything there is to work — they must be very happy.

WHICH ANTENNA WORKS BEST?

The gain figures used in advertising can sometimes be confusing. Here is the W2NSD/1 Datsun 24Z with two magnetic mount 5/8 wave whips and a bumper mount 5/8 wave. Some bad things have been said about the magnetic mounts so we decided to check it out and see what difference there was between them and a substantial bumper mounted antenna.

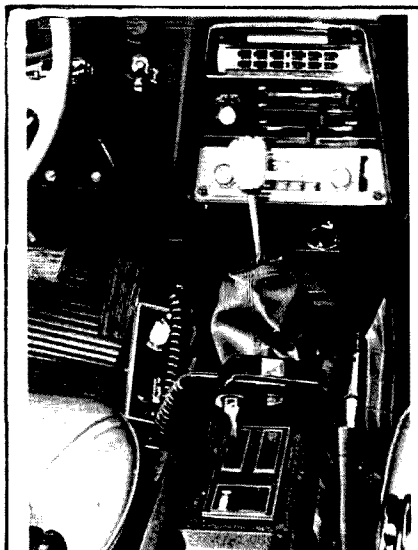
You can't just switch from one antenna to another because the "picket fence" phenomenon causes the signals to go up and down by several S-units every time you move a few inches. This means we had to drive around and try to find average figures — peak figures — etc. After a lot of driving and antenna switching, there was little doubt as to which antenna worked far better than the others — none of them. We could not really see any significant difference and that is a fact.

The extra antennas have been removed and the car now looks a little less like a moulting porcupine.





Jean Shepherd K2ORS, at the recent FM Symposium run by 73 Magazine, talks from one table to another over the din using an rf boost. After the dinner Shep gave a performance which resulted in laughing fits for a good part of the audience — three hernias and one double hernia. Two representatives of a national amateur organization were there — one smiled — briefly.



SHEP PR DEPT.

Jean Sheperd's America will be back on PBS television starting July 6th at 8PM on Thursdays. Don't miss this interesting series by one of our old time amateurs K2ORS. It won't hurt to drop a letter to your local PBS station telling them that you want to see this series — they are very responsive to such letters.

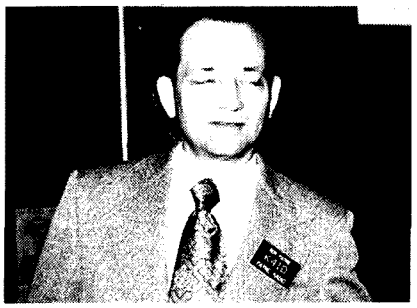
MOUNTING THE RIG

What do you do when you succumb to buying a car which turns out not to have any reasonable place under the dash to mount the FM rig? Here is the cockpit of the Datsun 240Z which has one of those molded paperboard dashboards with just no place to hang a rig.

The bracket for the 826 was mounted on the transmission hump and the rig slides into place easily. It takes but a minute to remove it for crystal changes and it is out of the way of the leg. There is room for a second 826 on the right hand side of the hump, if you need to go for 24 channels in your area and have the loot. The power amplifier — TPL — 120 watts — is under the seat — also out of the way.

The next step is a touchtone pad and tone burst unit which will go in place of the pencils on top of the hump. The hand mike will eventually be replaced by one fastened to the sun visor and a push-on push-off switch will operate the rig — thus making driving a little safer. Even as handy as the mike is, it would be better not to have to use one hand for it.

AT DAYTON



Don Payne K4ID. Perhaps you've noticed the growing ads in 73 by Payne Radio. Don has been bringing the Signal One transceiver to the attention of amateurs through his ads. . .and selling this incrediple new unit.



Fred Deeg K6AEH, president of the Palisades Amateur Radio Club (last we heard) and sales manager of Standard Communications. Fred is an avid two meter FMer and has had a lot to do with the most used Los Angeles repeater, the PARC WA6ZDI station. Fred is deeply involved with the soon-to-be-announced Standard repeater package



Tom Litty K6RAD shows his new 220 transceiver (marketed under the Tempo name by Henry, but made by TPL Communications in Hawthorne, California). This unit is both an FM crystal controlled transceiver and an AM tunable receiver with transmitter vfo! The price is expected to be in the neighborhood of $220, which is sure to be a very popular neighborhood. Looking on are Gene Hastings W1VRK and Eli Nannis W1HKG, the two powers behind the Boston and Swampscott conventions.

AMSAT NEWS

Michael Frye WB8LBP
640 Deauville Dr.
Dayton OH 45429

Receiving A O-C Signals

Very soon, AMSAT in cooperation with NASA will launch its sixth satellite, AMSAT–OSCAR–C. A-O-C will be a real step ahead for amateur radio. It will enable hams from all over the world to participate in some of the rarest DX ever.

Most hams are already aware of this. However, very few still understand completely how to get the most use out of A-O-C. The first thing the average ham asks is, "What type of equipment do I need," and "where do I aim my antenna" etc. This column is designed to give the straight details plus a little help to the person just starting.

Transmitter

The first step is putting out a good signal on two meters. The satellite receives signals between 145.9 MHz and 146.0 MHz. It will accept any mode appearing within this band and repeat it. CW or SSB are recommended because they utilize A-O-C in the most efficient way. As far as power goes, 100 W of effective radiated power (erp) is just right. Any signal stronger than that will overload the receiver or increase the gain, thus reducing A-O-C sensitivity.

Finding such a transmitter, if you do not already have one, is not really as hard as it sounds. First if you are a do-it-yourselfer, you can assemble a neat little rig that puts out about ten watts on two meters, then use a 10 dB antenna to bring the signal up to full strength. Second you could convert any of a number of surplus 2m rigs to CW by keying the carrier. In other words, this does not have to be an expensive endeavor.



Dave Ingram K4TWF, who writes the SSTV news in 73. Dave is one of the more prolific writers on the subject and has been responsible for a good deal of the interest that has grown in this fascinating new aspect of amateur radio.

Receiving

Most good amateur receivers capable of receiving 29.45 MHz will be fine for receiving signals from A-O-C. Receiver sensitivity and selectivity should be fairly good; however, since there is a high level of man-made and galactic noise on ten meters an extremely good front end is not required.

Antennas

The antenna that you use will probably be the most critical item you will need. Because it will determine the effectiveness of your station, the ten meter receiving antenna is the most important. Some form of directive array is recommended. A height of 50 feet off the ground is probably the all around best. Antennas mounted higher, thus having a low angle of radiation, will be best for DX work since the satellite will be near your horizon. For local contacts the lower antenna will pay off because of its high take-off angle.

For the 2 meter antenna a simple dipole will do, or a directive array depending on the transmitter's erp. If a beam is used it has to be aimed in the general direction of the satellite. A good idea is to mount it at a fixed elevation angle of 30°, since this will afford the broadest take-off angle. Again for the DX hunter the antenna should be mounted normally since this will aim the boom at the horizon for low angle shots.

Since A-O-C will last for about a year, this column will continue to inform on techniques and latest happenings in the mission. For all those interested in receiving additional data such as an A-O-C telemetry chart individual system explanations, and command functions. Please send SASE to me and I will send you a free copy.

FLASH!

Just before press time, we learned that A-O-C will not be launched in July as scheduled. The new launch date is still unclear, but it is expected to be in the late fall or early winter. Keep reading *73* for details of all OSCAR flights.



The South Milwaukee Amateur Radio Club will hold its third annual Southeastern Wisconsin SWAP-FEST on July 15th at Shephard Park (American Legion Post 434), 9327 So. Shephard Ave., Oak Creek, Wisconsin. The activities will start at 7:00 A.M. and run until 5:00 or later. There is plenty of parking and a picnic area. Admission is $1.00 per person. Bring your friends and whatever goodies you have to swap or sell. For more information write to A.R.S. WB9EQA, William N. LeCourt, 1900 West Kimberly Ave., Milwaukee, Wisconsin 53221.

* * *

Model Rocketeers will hold an on-the-air convention on July 15 at 1800 GMT on 3,992 and 14,300 - each give or take a little. The Ludlow (MA) Amateur Radio Club is sponsoring the convention, and net control will be WA1NIC.

TWO RIVERS HAMFEST

The Two Rivers Amateur Radio Club of McKeesport will hold its annual Hamfest on July 16, 1972, at the Clairton Sportmans Club off Rt 51, near Pittsburgh, Pa. For flier write WA3MWM C. Thomas, 7022 Blackhawk, Pittsburgh PA 15218.

* * *

The annual Indiana Radio Club Council Picnic and Hamfest will be held on July 9 at the Lafayette Fairgrounds. There will be a flea-market for the hams and fun and games for the rest of the family. Trailer parking is available. Indiana's Ham-of-the-Year award as well as other operating awards will be made. Tickets are available from any IRCC club, or by mail, or at the gate. Advance tickets are $1.50 each by mail from W9YIP, 477 Robinson, West Lafayette, Ind. Orders should be mailed by July 4. Enclose payment and SASE. Tickets at the gate will be $2.00. There will be advanced and grand prizes as well as other prizes.

* * *

The Annual Wyoming Hamfest will be held July 15th and 16th 1972 at the Holiday Inn, Thermopolis, Wyoming. There will be prizes, a banquet Saturday night, Swapfest, Technical talks, Ragchews, Representatives from MARS, etc. Talkin on 3920 and 2 meters. Golfing, swimming and picture taking of the buffalo that roam at will in the State Park. The Hamfest is sponsored by Mildred and Joe Ernst of Thermopolis.

* * *

ONTARS, the Ontario Amateur Radio Service, sponsored by R.S.O. Inc., operates daily, all year, from 7AM to 6PM local time on or about 3775 KHz. It is a public service net for the express purpose of handling traffic, but check-ins from stations without traffic are most welcome.

A cordial invitation is extended to our American amateur friends to avail themselves of this service. ONTARS net control will recognize check-ins from all modes - SSB, AM and CW. For US amateurs operating mobile in Ontario this is an easy way to obtain traffic information, directions, etc. and meet new friends.

ONTARS will be looking for those W and K calls.

* * *

The first annual picnic of the Northwest Amateur Monitoring Service (NAMS) will be held Sunday, 16 July 1972 at Lewis & Clark State Park about 10 miles south of Chehalis, Washington, on old Highway 99.

NAMS will be one year and one day old on the day of the picnic. Overnight camping is available at Lewis & Clark State Park, with 40 spaces available. Bring wood for campfires, and bring food - it's a pot luck picnic, begins at 1 PM.

1972 County Hunters Contest July 29–30, 1972

The CW County Hunters Net invites all amateurs to participate in the 1972 CW County Hunters Contest. All mobile and portable operation in less active counties is welcomed and encouraged.

Contest period: 0000 GMT July 29 to 2400 GMT July 30.

General Call: CQ CH: Exchange - QSO number, Category (portable or mobile), RST, State (province or country) and county (U.S. stations). Scoring: QSO's with fixed stations are 1 point, QSO's with portable or mobile stations are 3 points. Multiply the number of QSO points times the number of U.S. counties worked.

Logs must show category, date/time in GMT, station worked, exchanges, band, QSO points, location and claimed score. All entries with 100 or more QSO's MUST include a check sheet of counties worked or be disqualified. Logs must be postmarked by Sept. 1, 1972 and sent to CW County Hunters Net c/o James E. Hoffman K1ZFQ 42 Gresham St., Milford CT 06460.

* * *

The Dade County Amateur Radio Public Service Corps will operate Special Events Stations from the National Political Conventions, Miami Beach, Florida during July and August. Tentative planning: Formal traffic Schedules and traffic nets. Contact frequencies 7072 14072 CW, 7272 14317 SSB. Station hours - 10:00 AM - 10:00 PM EDT, 1400Z - 0200Z. Calls/Dates - WD4USA, Democratic, July 10-13, WR4USA, Republican, August 21-24. QSL Info (SASE) to: Special Event Station (call), PO Box 501, Miami Springs, FL 33166.

* * *

The Quebec's amateur radio association, R.A.Q.I., will be holding its annual convention at the Cite des Jeunes in Vaudreuil Que. on June the 30th, 1st and 2nd of July. All amateurs of course are welcome and we will have french and english talks on technical subjects. Also, door prizes will be given during the convention, including 2 main prizes which will be awarded at Sundays's banquet.

* * *

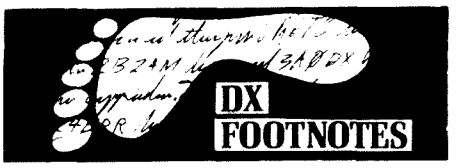
The largest meeting of radio and electronic enthusiasts in the midwest is scheduled for Radio Expo '72 at the Lake County Illinois Fairgrounds on July 8 & 9. There will be technical talks, meetings, flea market, and something for the whole family. Advance tickets are only $1.50 ($2 at the door) from Radio Expo '72, Box WA9ORC, 230 East Ontario St. Chicago IL 60611.

* * *

The Columbus, Ohio Amateur Radio Association has been granted use of the special event call sign WJ4ULY. The club will be broadcasting both phone and CW from Independence KY on July 4. Only US stations will be worked on 40 and 80, DX stations will be worked on 20, 15, and 10. There will be Novice stations active also QSL via W8TO; enclose SASE.

* * *

The Wabash Valley Amateur Radio Association will hold the 26th Annual Hamfest, The VHF Picnic, on Sunday, July 30, 1972, at Turkey Run State Park near Marshall, Indiana. Registration is $1.50 each with no advance registration. There will be prizes, Bingo games for the XYL, big flea market and plenty of good fellowship. Talk in will be on 52.525 and 146.94.



(The following letter, all of it, was written on an airline place mat – Ed.)

I arrived (I'm here in Dr. 9VINR Charan's office, & he keeps bringing in patients, & I just get up & leave when he comes in) here Thursday fr Bangkok, as my time was up that was stamped on my passport. Had been issued the call of HS1AGO while there. Worked many sta with HS call and 9Y4VV Nazir dn in Trinidad, but we never hrd 1 Stateside call. Nazir gave me a 5–9 report. Doc just handed me yr letter of Oct. 71. I'd left the States bk in Nov. Flyin to Lima Peru on my way to visit XS4AA Basil, but stayed in Peru for 3 days visiting hams. Then flu over to Sao Paulo & eyeballed with Brasilian hams, then flu up to Rio where I met & visited many hams in Rio. After 4 days, took off & flu 4280 mi NS to Johannesburg, then drove 130 with Basil to his QTH in Kroonstad. While there for 2 weeks, I wire-brushed & painted his 70' tower.Then contacted K6UJS the night B-4 I left for Cape Town, or ZS1Land, who had my XYL on the LL as a SWL telling him where I was goin. Next day I hitched rides down to C.T. & stayed with many hams in the area ZS1UP was one of them, John, whose son Willie's picture was in the South African paper a week after I was there right on the front page in his plane, upside down flyin over CapeTown.

After meeting many members of my Mormon Church at the services there in CapeTown, I went to the BOAC office & instead of routing me bk to SF via London, she sent me to Nairobi where I met Robby 5Z4ERR & several others & also goin on a small Safari to hunt (but I didn't do any hunting) just went along for the ride in their LandRover & took a few pictures) No room on this paper to elaborate abt my thrilling experiences while there in Kenya. However, after meeting many of the local 5Z4 boys, I caught a plane to Bombay via Uganda & Kuwait. Upon landing at Bombay I had a hotel res at a lovely hotel (paid for by BOAC) because I wanted 24 hrs to contact any VU2 hams, which I managed to do. I met Ali VU2ST & his ham son, who drove me clean across dark Bombay at night (without lights) to his QTH where I met Ali & other both on the air & with the ol eyeball. By this time, it was abt time to catch my flight to Bangkok which was very much appreciated, as we were served a delicious American dinner (after eating stuff I wasn't used to eating) bk there in Bombay.

Well the first thing I noticed after bein in Bangkok a few hrs. was everywhere you looked there, beautiful women . . . all over the place, everywhere.

My visa for my visit to Thailand was up Jan. 28th, we (meaning me) left the 27th (didn't take the XYL B-cause, all she wanted to see was Japan).

Flu into Singapore at 1530, plenty of time to call & make contact with Charan 9VINR, whom I'd QSO'd previously. Said he'd find a place for me. I'd contacted Ruspy DU7ER fr Bangkok on the SEANet with Baddy 4S7PB in Celon as NC & told Ruspy (with my HS1AGO call, that I wd B comin dn to eyeball with Doc Charan in Singapore in a week & if he shud also happen to contact any Victor Sugar stas to B sure & tell them that K6OnlyPrettyGirls (many hams know me by my call) wd B visiting Hong-Kong on his way bk to his QTH there in San Francisco.

So Wayne, I'm sending you this letter to help you better realize just how wonderful a trip I had visiting the many ham friends that we've contacted in past years. I forgot to mention, Thursday evening (when we got in fr Bangkok, we just happened to hit it right because that nite, 9V1NR & I HS1AGO (K60PG) attended the semi-annual meeting of the Singapore Amateur Radio Club, & I got to eyeball many hams I'd QSO'd with, & also I was lucky enough to see the picture I've been trying to see for a long time, bk in the States, Radio Amateurs of the World.

Now, just as soon as the good doctor (who's sitting in his office, filling out dozens of QSL cards, which I think is very commendable) is ready, we're goin dn two a place called Johore Bahru, which is here in Malaysia, to visit some of his friends.

I'm sorry that after QSO'ing Bud 9V1OI many times, he's not here, but up somewhere in Vietnam waters operating MM fr his dredge with the call of W7RMT. Charan & I were drivin to his office, & he said to me, see that nice beam up there on the top of an apt building, well that's Bud's 9V1OI's QTH he left behind.

Many tnx agn Wayne & 73s fr Singapore,

Kenny K6OPG

* * *

Following are instructions for obtaining reciprocal operating privileges in Suriname: Because of an agreement between the USA and Suriname, there are no objections against the issuance of licenses to holders of a valid FCC license, during their stay in this country. Applications must be addressed to: The Governor of Suriname, Through. The Minister of Public Works and Traffic, Kleine Waterstraat 8, Paramaribo, Suriname.

With this application an official stamp of Sf 0.30 must be placed and payment of legal charges of Sf 6.00 and an administration fee of Sf 1.00 are due. In order to meet the requirements, send the application and an amount of U.S. $5.00 3 months before the date of arrival to: The Government Telegraph and Telephone Service, Bureel Radio Controle, Keizerstraat, Postbus 1839, Paramaribo, Suriname. The change will be handed to you upon your arrival. Complete and sign the information form that is returned to you and forward it also to The Government Telegraph and Telephone Service.

The license fee per annum is SF 10.00, payable when you are here. Once in Suriname, contact the Government Telegraph and Telephone Service and you will receive further information.

* * *

The *Mobile News* reports that Portugal has signed reciprocal licensing agreements with the following countries: Belgium, Canada, France, Germany, Holland, Morocco, Switzerland, the U.K., and the U.S.

Here is a list of addresses to which to write when requesting licensing information in the Caribbean:

BARBADOS
Ministry of Communications,
Works & Housing,
Government Headquarters,
St. Michael, Barbados

JAMAICA
The Postmaster General
The General Post Office
Kingston, Jamaica

ANTIGUA
The Posmaster
General Post Office
Antigua, Leeward Islands

GRENADA
Ministry of Communications & Works
St. Georges
Grenada, Windward Islands

MONTSERRAT
The Postmaster,
The General Post Office
Montserrat, Leeward Islands

ST. LUCIA
Ministry of Communications & Works
St. Lucia, Windward Islands.

ST. KITTS, NEVIS, ANGUILLA
The Administrator
St. Kitts, Leeward Islands
(Note. There are at present certain administrative difficulties in this

group which may present some problems in obtaining licenses in Anguilla.)

TURKS & CAICOS
The Administrator's Office
Turks & Caicos Islands

BRITISH HONDURAS
The Postmaster General
Belize, British Honduras

* * *

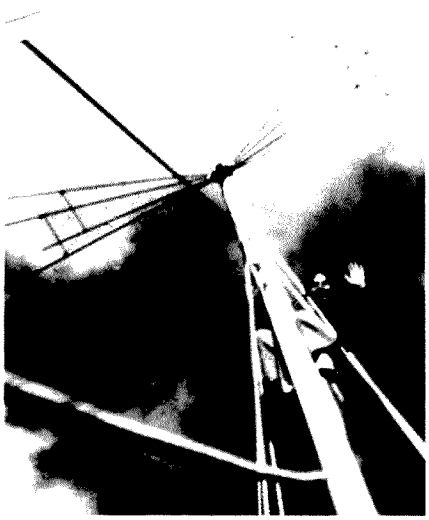
DX LETTERS

Amateur operation here in Germany has been a pleasure I never thought it could be back home. Of course, we have our shared bands with commercial services, lots of QRM (some of it intentional) and certain restrictions, but you don't need a KW to work in DXer's Heaven. One thing we do lack is a Third Party Agreement between the U.S. and Germany – no phone patches are allowed.

We would like to hear more Stateside stations calling Europe on 80 meters. Although our band stops at 3800 kHz, the portion traditionally reserved for working DX is 3790–3800, and you don't have to be an Advanced or Extra to work us. If you can work split frequency, you *can* work us. Just give a listen in our DX portion. We usually indicate what frequency we're listening on, but we do listen all over the band, including the General portion.

On 20 meters, we'd work a lot more of you in the Central and Western states if you'd beam the long path over New Zealand. The south polar route works beautifully! Try around 1400 GMT.

Harry K5HML/DL4HW
APO New York 09053



Enclosed are two prints showing the "Ham Quadri" antenna installed on the *Lady Mary*. Mary, WA6VIB, is still located at Manzanillo, Mexico, but is leaving for Acapulco soon.

Bob Wilkinson WA6RFB

THE TRAVELING HAM

Joe Kasser G3ZCZ/W8

This column is a forum on information and ideas enabling the traveling ham, be he tourist or commercial traveler, to take his ham rig with him and to successfully operate from overseas. The advent of solid state VHF FM and low power subminiature HF equipment has made portable ham stations an everyday occurrence.

The USA now has reciprocal licensing agreements with many countries. Some of these countries, especially in Europe, have a VHF phone (144 MHz and up) class of license that does not require a Morse code test. Thus American Technician class operators should be able to obtain reciprocal permits. These are well worth acquiring because there is a high level of VHF activity in Europe.

Consider the two meter band: in Europe the international two meter (mobile) calling frequency is 145.0 MHz. It is used by both AM and FM stations, but mostly by FM. There is also an international SSB frequency centering on 145.410 MHz. Europe is in Region One of the IARU and as such the two meter band only covers 144–146 MHz. Squeezed into those 2 MHz one finds AM, CW, FM, SSB, repeaters and beacon stations. The band is voluntarily divided: CW operators utilize the bottom 150 kHz, the beacons, although at present all over the band, will soon move up to the top end and occupy the top 50 kHz. The phone operators have the rest using AM, FM and SSB. Many cross mode contacts take place.

There is no six meter band in Europe, but the United Kingdom, Eire, Iceland and Gibraltar have a four meter band at 70 MHz. In the summer, sporadic E skip conditions occur, allowing DX contacts across the continent. This band was a popular mobile band in the UK, until the Class B (VHF Phone Only) license allowed two meter operation without a Morse code test (but with the same technical exam as the Class A (All Band) license. Two meters has become the prime mobile band and has resulted in the establishment of simplex channels for mobile use. For example, 144.48 MHz is a popular channel in London, England.

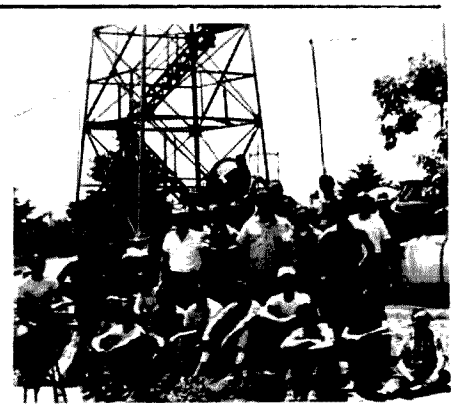
With the many high-rise hotels, tall buildings and hills dotted all over European cities, the use of a TR-22 or similar hand-held rig results in many contacts. If you think there is no one to talk with, boy are you wrong! The strange accent usually starts a pile-up. Standing near the museums overlooking the base of the Eifel Tower in Paris I had numerous QSO's one winter evening a few months ago both over the air and with curious courting couples at the site. (I would have been up in the Tower except for the fact that it was closed.) Language was no problem, I couldn't even begin to use my French since they all insisted on using English. So with a few words of English, a few words of French and lots of enthusiasm, we managed to communicate.

Next time you go to Europe, take a VHF hand unit with you (get a reciprocal permit first) and have fun. The QSL's are interesting too and make fine souvenirs. How many hams do you know who have QSL cards from G8's, FL's, and DC6's.

Next month I'll write about HF operation, but in the meantime if you have any tips, experiences or ideas to pass along, please do.

Log of W7DXX/1 20 SSB

JX2HK is quite active from Jan Mayen on 14.210. OY9LV is trying split frequency operation. Ole often transmits around 14.220 while listening around 14.300. Thanks to Jim for a very good DXpedition to Market Reef with OJØSUF. QSL via OHØMA . . .EP2TW, ALF via GI3HXV. UH5ØD and UG5ØA are special call signs for Russia, a 50th anniversary celebration. 9N1MM, AF5FX, KS6DY, CN8CJ, OD5BV, MP4BBW SVØWZZ, DL8NU/OHØ, WA2BVU/4X (QSL via W2DYN) are quite active stations and easily worked (they're good operators). Carlton Ross, W9ABA, of Ross and White, operates each Feb. from Grand Cayman Island under the call ZF1BR. QSL via W9ABA. That YI2AZ who appears once in a while on 20 appears to be a pirate.



Here's the whole gang that set up and operated W1DC this last June for the VHF Contest. They operated from Pack Monadnock Mountain in Peterborough, N.H. and put out one whale of a signal on all the VHF and UHF bands.

50 MHz BAND

Bill Turner WAØABI
5 Chestnut Court
St. Peters MO 63376

The skip season is here and if the first two weeks of May are any indication, this should be a dandy year. The band opened nearly every day and in all directions. Reports from various parts of the country confirm local observations that the buildup started in late February. WA5RBI reports Feb. 20th to have been hot from Enid, Oklahoma – the band opened for two hours to Ohio, Pennsylvania, West Virginia and Kentucky. Bob reports another opening March 4th, but with deep QSB, the same general area was involved with the addition of identifiable signals from Georgia, Louisiana, Texas, Illinois and Wisconsin. March 6th brought another opening, this time from the south and southwest. Stations worked included XE1PY, WA7BBM, WA7JEI and multiple 5's. Total elapsed time was an hour and a half starting at 0153Z. On the 8th of March the test pattern and audio of XHY-TV were received on channel 3 and another unidentified Mexican TV station on channel 2 with perfect picture and sound. "Started tuning 6 meters and found the following, 2340Z LU6ACL on AM . . .fair audio, XE3 on CW from Yucatan. At 0012 XE1JP, George, then worked WA5UMP, Jim from Russellville, Ark. on backscatter. On March 9th heard WA1JEX – worked him with the beam South (185°) with 5 x 6 signals both ways. By the way, XE1PY reports 37 straight days of openings there. Also he and Alfredo, LU3EX, have been logging and triangulating a steady carrier on 49.97 MHz. According to their figures . . .from the Northwest of Africa."

Bob, W4GDS, reports having worked XE1PY on backscatter at 2000Z on the 29th of March. Rusty had at the time been working South America for some two hours. Before the band closed at 2127 Bob had worked LU8D1N, LU3EX, LU2DEK, CX1AAX and CE4CP, all with S9 plus signals. I think I'll move South.

Both WB9JFT and WB4VLH report having worked Len, VE4QL. WØGNS noted 'stronger than horseradish" with his groundplane. Better get the beam back up Mac! Others noted as being very active in the past few months include Jack, WA5UUD, New Orleans and Joyce, WB5CUL, working her first skip. I wonder why most 6 meter YL's/XYL's are from the South?

The Itchycoo Park VHF Amateur Radio Society has announced the scores of participants in their 2nd annual "Worldwide VHF Activity." Highest overall score was the 600 points compiled by WA1NNW, who made 60 contacts, all on 6 meters. Other 6 meter leaders were WA3LKO with 250 points and 50 contacts and WA3PNW with 204 points and 51 contacts. Congratulations are due this group not only for sponsoring this "activity" but also for recognizing that a "contest" in which the sole aim is the exchange of callsign, section and signal report is of little value to the participant and a great detriment to normal operation on the band. The 1973 version of this activity is scheduled for 3 PM local time March 10, to 10 PM March 11, 1973. Full details will be published well in advance.

Six meters is looked down upon by many "higher class" licensees as the hangout of incompetents who are unable to pass the General Class exam and it must be admitted that there are those among us who leave something to be desired. But, is this not true of amateurs as a whole rather than Technicians alone? In Websters a technician is defined as "a specialist in the technical details of a subject or occupation" and a little research will disclose that this is exactly the case. Much of the blame for these opinions must rest on the publications which form the communication links between hams. So long as the modulated oscillator/rogen receiver articles are featured and the handbook tells the casual reader that the normal range of a well equipped station is 75 to 100 miles the situation will remain status quo. Anyone who has tried to sell AM equipment long ago discovered that there is no market for it, the average station runs 200 to 1000 watts of SSB and is capable of communication over distances of at least 300 miles. Is it not time too for the only national amateur radio organization to amend its structure to allow the holding of office by the 40% of the total ham population now excluded by the "General Class or above" clause? . . .WAØABI

SSTV SCENE

Dayton was once again a slow scan haven this year and I'm sure if you missed the '72 convention you will want to mark the '73 convention on your calendar. W9NTP and WB8DQT had some interesting gear on display and an "original" copy of the slow scan handbook. WØLMD had his integrated circuit half-cycle smapling monitor on display, and described it in detail during the TV Forum. K4JPE had a storage tube monitor that drew quite a crowd. (The pictures on these tubes get brighter instead of dimmer after being scanned.) There was some very good color fast scan gear and, of course, plenty of W6MXV and Robot units, plus individual booths for each. in what manufacturers designate a P7 Phospur tube. RCA excells in long persistance with in what manufacturers designate a P7 Phospur rube, RCA excells in long persistence with most tubes capable of holding an image 10 to 15 seconds, however, it was noted that some SSTV'ers had bought P7 cathode ray tubes that wouldn't hold an image long enough to view half a picture! Obviously the trend is toward RCA tubes for monitors, and moving the "short persistance P7's" into flying spot scanners.

How about a U.S. sponsored slow scan contest? Wayne and I have discussed the possibilities and we see no reason why this shouldn't be a real blast. This wouldn't be a contest to compete with CQ Electronica of Italy's slow scan contest, but rather in addition to their contest. Certificates to the winners would be no problem, and by the time the contest is on we may be able to come up with a trophy for the overall winner. First thoughts were for a 12 hour period contest late this fall. Since it is already August, we will need to hustle for a contest in, say November or December – what's your thoughts? It would be *your* contest – if you would like to see another slow scan blow-out drop me a card with your suggestion on a date and time. The cards are a must to prove the validity of the contest.

A lot of SSTV'ers have written asking where they might find 931 Photomultiplier tubes. A source may indeed be difficult to locate, for often distributors and surplus houses are rather high ($14.00 each) on them. Have you tried duplicating machine companies? Many stencil cutting machines use one or two 931's and usually these are pulled out when their sensitivity drops slightly (they only apply 650 volts on them, and have no sensitivity adjustment) so they are ideal for flying spot scanners. Another place to try is the local junk yards some autos use these in their automatic head light dimmer, and they can be purchased for 50¢ to $1.00. If you get two that don't match in sensitivity, try separate 3 meg pots in series with the -900 volt supply to them so you can apply a variable voltage to each one – this way you can balance their sensitivity. A "collar" made of heavy paper, sized to fit over the glass of the 931 and a 1/4 x 1" slit for light to reach the 931 grid cut in it can be used to control both sensitivity and picture shading – moving the slotted collar around will shade sides of the pictures. Naturally, moving the slit to the extreme sides will cut out all output. Happy hunting for 931's. . . .K4TWJ

Microwaves

FREQUENCY BAND DESIGNATORS

Paul Schmidt, W9IDP comments on the microwave band designators listed in the May "72 issue of *73* as follows: *"On page 12 Jim Weir has listed. . .the OLD designators. The Department of Defense has. . .issued. . .new designators. (He) should have known that the new designators are official, and are being used in MIL-SPECS and MIL-STD's."*

Paul, I did know that the DOD had issued these new band designators, just as I know that Hewlett Packard had issued their own band designators, and the ITT Handbook had chosen still a third set of letter designators. The question, then, is: what constitutes the "official" nature of a band designation? Taking a rather pragmatic approach to the problem, I say that the *usage* governs the correctness or incorrectness of a symbol. Now, taking any of the wave trade magazines, including the most prestigious of them, you will be hard pressed to find a single reference to the new designators. However, references to "S" band telemetry (2290 MHz) and "X" band waveguide (10 GHz) are quite prevalent.

I do *not* on the other hand, disagree with you. I think the adoption of this system would only be second to the adoption of the metric system in helping the microwaver in his work. It is, in short, the best system of designators ever designed for microwave work. With your kind permission, I will repeat my designators, and alongside them your new system of designation. Perhaps order will come of this chaos yet.

OLD LETTER	FREQUENCY
P	200–400MHz
L	400–1500 MHz
S	1.5–40 GHz
C	4.0–6.0 "
X	6–12 "
K	12–36 "
Q	36–46 "
V	46–56 "
W	56–100 "

NEW DESIGNATOR	FREQUENCY
A	0–250 MHz
B	250–500 "
C	.5–1 GHz
D	1–2 "
E	2–3 "
F	3–4 "
G	4–6 "
H	6–8 "
I	8–10 "
J	10–20 "
K	20–40 "
L	40–60 "

The problem I see arising in the transition period, between the time the old symbols fade away and the new ones replace them, is one of letter confusion. For example, if I told you I had 20 watts at C-band, you wouldn't know whether I had made a breakthrough at 5 GHz, or had something that was fairly common at 500 MHz. Do you see the problem? The same problem arises when speaking of K and L bands. Both systems use K and L so I feel that we must be rather careful in the use of this new system.

Jim Weir WB6BHI
P.O. Box 23233
San Diego CA 92123

READER REVIEW

KENWOOD TS-511S TRANSCEIVER

I get equipment "jitters" every couple of years of so and when that time came around recently I was determined to purchase an uncompromising transceiver; usable with good effectiveness on both CW and SSB – *and* be satisfied with it for more than a couple of years. After four months of operation, it appears I made a good choice.

Advertising in 73 affected my decision. I ordered my rig sight unseen, since my dealer in Muskegon did not have a unit on display. I waited four long weeks for delivery due to the West Coast dock strike. I paid the whole wad – full rig price, sales tax, surtax, and shipping. The Kenwood line is fair traded by most of its dealers. While awaiting the arrival of my TS-511S, I became aware that Allied Radio of Chicago had just discontinued marketing a transceiver quite similar in physical appearance, but closer examination showed the Allied unit used more tubes, used 6146 finals (lower PEP) had the CW filter standard, but lacked a noise blanketer. Later, I also noted the Allied units manual was much more complete in circuit and trouble shooting detail than the Kenwood TS-511S. Both units are definiately manufactured by Trio of Japan.

I received the unit two days before New Years – and on New Years Day, it quit; that is, the unit no longer dipped out (resonated). Replacing the finals did not correct the problem. After a few minutes checking, I noticed a loose gear drive on the end of the band change shaft which engaged a gear driven rotary switch in the tank circuit. A dual set screw gear had worked loose, caused by changing bands, and was not changing the rotary tank circuit taps. Since this may happen in other units, I wrote Henry Radio and advised them of the problem. With the unit's cover off, I could readily see the excellent construction techniques used. All circuits are on isolated boards, subdivided by section (i-f, audio, etc.). The TS-511S performs superbly, with only minor quirks. I highly recommend the 500 Hertz CW filter option. This option, with the rig's RIT feature allows an almost separate" transmitter and receiver type quality operation. Even the occasional CW op will want the filter – it is much better than audio restriction type filters. The unit's S meter pins on almost all signals 80–20 meters, when adjusted per instructions. The receiver did not swamp or overload under most signal conditions. The slow/fast agc circuits handled signals properly, and allows operator choice when conditions or modes change. The dial linearity is very good from band edge to edge. Once you get used to 1 kHz readout, you'll never accept less accuracy. The bands are covered in 600 kHz segments and conveniently cover many MARS frequencies without the modifications necessary on other rigs. There *is* a carrier frequency jump from upper to lower SSB, and to CW (with the filter), but in most cases this is no problem. The noise blanketer is effective for impulse type noise such as automobile ignitions, however it is only fairly effective on some car ignitions. Fortunately, I don't live near an expressway.

The transmitter tuneup is typically quick and easy, of the better transceivers available today. One can either tune up by the maximum rf out method or the conventional load and plate tune method. The meter checks the four vital functions on transmit and is an S-meter on receive. 6LQ6's are used as finals. Tune-up key-down is kept to a bare minimum as with all sweep tube rigs. A screen grid on-off switch is provided for improved final neutralizing when necessary. Audio reports are good, and the alc circuitry works well under properly adjusted microphone level conditions. A cooling fan is standard equipment for the finals. Actually, the rig is highly transistorized, and hardly gets warm even over extended periods.

In summary, I'm glad I purchased the Kenwood, and I plan to hang onto it. Parts and service are available from Henry Radio directly, as most of the dealers handling the Kenwood line are qualified to give technical advice and do minor repairs, but do not stock the parts or circuit boards. American manufacturers should wake up to the fact that the Japanese equipment now has a firm foothold in America in terms of price, quality, state-of-the-art designs, and service. My advice – consider the Kenwood. It's a gem.

David Alan Linderman WA8IKP
Grand Rapids MI

Joseph M. Plesich W8DYF
RD 1
Irondale OH 49932

Your Ham Club - Interesting?

Or Boring!

How are things going at your ham club meetings these days? You say things have been dragging a little? The fellows are tired of having the same old program every week? If this is the situation at your club, now's the time to do something about it while the fellows are still showing up at the meetings.

Let's start by making sure that the club members are reminded to attend the meetings. Your club secretary can send post cards to them, meeting announcements can be sent to the local newspapers and radio stations, and they can also be reminded over your local VHF net, if you have one. If you don't have one, why not start one? Local nets are a big help in holding clubs together. One suggestion made by a club secretary whose club meets bi-monthly, is to mimeograph a sheet of paper with the dates of all the meetings and net nights of the current year, and to distribute it to all the members so they can tack it on the wall of their shacks.

Now that everyone knows on what night your club meets, how do you keep their interest and how do you get them to keep coming to meetings? Perhaps part of the answer lies in a well-organized meeting.

One successful club has their meetings divided into the following three activities.

1. Business meeting – thisportion of the meeting should be long enough to take care of the business and short enough to keep everyone from becoming bored. Your president should have a big gavel and use it. Without at least some semblance of order, nothing will be accomplished. However, don't be too strict. Remember, ham radio is a hobby, and the fellows do come to the meetings to enjoy themselves.

2. Coffee and doughnut break – this isn't absolutely necessary but it is always welcome. You know how everyone likes to raid the refrigerator during the commercial. Try to buy your own coffee maker. It will come in handy for other activities such as a field day, mobile outings and picnics. Also, to keep from drawing upon the club dues for refreshments, keep a "kitty" next to the coffee maker and let the fellows "feed her" according to the dictates of their consciences.
3. The planning activity – this is by far the

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most important part of the meeting. Let's start at the beginning: First, an activities committee and chairman should be selected and be responsible for all meeting programs. The chairman should be a dynamic, vigorous person with a forceful, but pleasing, personality. Choose him carefully, for he might well be the most important member of your club!

Below is a list of some suggested club activities. Once you get to thinking about it, you'll be able to add several more to the list.

1. Try a field trip to the electronics department of one of your local industries.

2. Movies are always welcome. Get a list of movies and film strips from QST, your local library, and your local phone company.

3. Have a demonstration. This could be an artificial respiration demonstration by a member of your fire department or Red Cross chapter, or the display of a piece of gear constructed by a member of the club.

4. Construction projects. This can be anything on which the club decides, from UHF gear to a coil loaded bobby-pin vertical for 80 meters.

5. A question-and-answer forum. Get three or four of your "brains" to sit on a panel and let them solve problems tossed at them by club members. It will be a lively evening!

6. Speakers from business and industry. Another idea is to have the members talk about their pet interests, such as DX, traffic handling, etc.

7. Have a joint meeting, picnic, or dinner with another club. If you are really objective in your thinking, you might even do this with a CB club!

8. Mobile hunts. About February, a committee should be appointed to decide the ground rules for your summer mobile hunts. This should include bands operated, area covered, gear used, and prizes. Mimeographed maps of the area to be covered during the hunt are nice to have, as well as picnics after the hunt.

9. Contests. Who can work the most countries from one meeting to the next? How many stations can a club member work in an hour? Who can work the greatest distance with the least amount of power? Keep thinking – you'll come up with many more ideas.

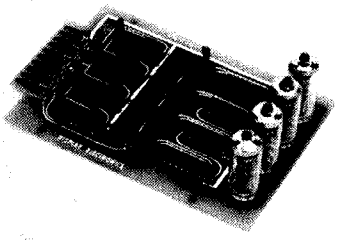
10. Have an auction. It is plenty of work but it can be lots of fun as well as a profitable venture for the club. Careful planning and lots of publicity is the secret of success here. Try to get a good auctioneer. He should be witty, comical, bubbling over with personality, and have plenty of gab.

One way to cut the club in on the profits is for the club to take 5–10% of the price of the piece of gear that is being auctioned. It is a dandy way to add to the club treasury once or twice a year.

Well, that's about it, fellows. Try to put a little life into your club and you'll watch it grow and prosper. Also, you'll have lots of fun doing it.

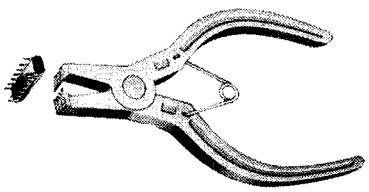
...W8DYF

NEW PRODUCTS



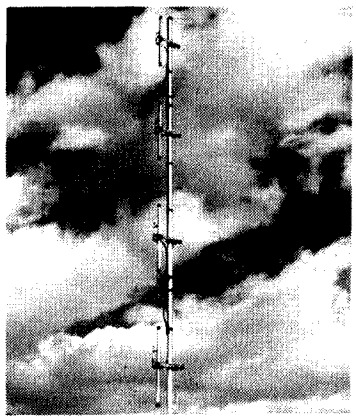
CM COUNTER AND DISPLAY MODULE

The new Series CM Counter and Display Modules, provides a convenient reasonably priced solution to a variety of counting and display requirements. Modules in the series are available in several different numbers of digits with each digit including a decade upcounter, memory latch, decoder-driver and readout tube. Since the incandescent readout tube operates from 5V dc it eliminates the need for an additional power supply. Each character is nearly 1/2 inch high and will provide an attractive, high contrast display when viewed through the polarizing filter accompanying the module. The 7400 series TTL integrated circuits and readout are assembled on a G-10 fiberglass printed circuit board. Connections to the module may be made through the rodium plated edge connector or directly to terminals. The module features zero blanking and a lamp test control. Each module is thoroughly inspected and tested before shipment. A complete schematic and instruction sheet is included with each unit. Write to *Display Electronics, P.O. Box 1044, Littleton, Colorado 80120.*



NEW TOOL

Experimenters will delight at this new integrated circuit inserter/extractor. No more will you need to keep a bottle of iodine on the bench. The Starnetics unit operates like a pair of pliers with a spring loaded handle so that you do not squeeze the DIP into a squashed spider. Metal teeth also act as a heat sink while soldering. And to prevent waste, leads on old ICs can be straightened. This is certainly a universal device for the home builder. It costs less than twenty dollars from *Starnetics, 10039 Riverside Dr., No. Hollywood CA 91602*



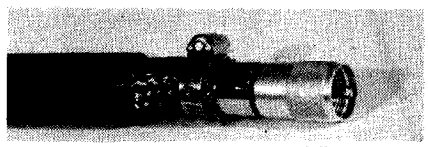
REPEATER BUILDERS NOTE

Cush Craft announces the addition of two new models to their Four Pole antenna design. The Four Pole is a series of four stacked dipoles for amateur FM applications. Four Poles are supplied with the dipoles mounting booms harness and all hardware. Center support mast is not supplied which allows the user to custom select a mast for his installation or to tower mount the antenna. Gain figures for the antennas show 6 dB omnidirectional and 9 dB semidirectional pattern. Available for the 144, 220 and 435 MHz amateur bands. For more information, write to *Cush Craft, 621 Hayward St., Manchester NH 03103.*



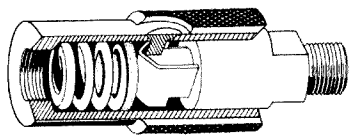
PORTABLE MONITOR RECEIVERS

Now you can listen to the repeaters wherever you go. Tune them in with the Hallicrafters portable monitor receivers. These radios feature continuous tuning over the 27–49 MHz or 144–175 MHz ranges. They have adjustable squelch controls that eliminate background hiss. The rf stage lets you hear the weaker signals and the tuned i-f stages let you separate stations on nearby frequencies. Each of these radios has a nine transistor complement and provides all the sensitivity and audio that the average repeater monitorer wants. Price of these units is under forty dollars. For more information, write to the *Hallicrafters Company, 600 Hicks Rd., Rolling Meadows IL 60008.*



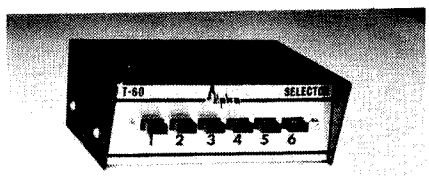
COAX CONNECTOR

At last! A low priced connector for RG-17/U coaxial cable. RG-17/U coax is a low loss and flexible cable suitable for amateur use. It is also inexpensive when compared with alumium hard line and other low loss transmission lines. This connector enables the RG-17/U to be connected directly to an SO-239 receptacle without an adapter. The connector may be used at frequencies up to 550 MHz with negligible insertion loss. In addition, no special tools are required for a solderless installation that is completed in minutes. For more information write *Wayne Smith Products, P.O. Box 46521, Bedford, Ohio 44146.*



QUICK ANTENNA DISCONNECT

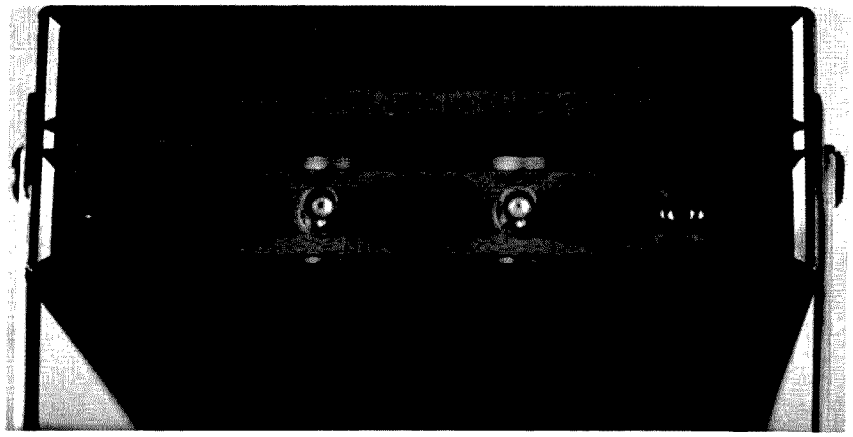
NEW-TRONICS CORPORATION announces the first available 100% stainless steel Quick Disconnect for instant press and twist removal of a mobile antenna from its mount. Lifetime performance is assured in this heavy duty assembly with special encapsulated design and stainless steel spring for freedom from sand, dirt or ice jam-ups. The Model QD-1 will accommodate small, medium or large antennas with 3/8"-24 base. For additional details write: *NEW-TRONICS CORPORATION, Sales Department, 15800 Commerce Park Drive, Brookpark OH 44142.*



NEW TONE ENCODER

Repeater users who frequent tone-entry repeaters should consider the new Alpha Electronics MT-60 tone encoder with six selectable tone frequencies. Each tone is completely adjustable from 20 Hz to 300 Hz, and the tones can be continuous or pulsed. The beauty of this unit is that it also is a tone decoder. Several hams can have a selective calling system so that only the desired station can break the squelch. Different combinations of encode and decode functions can be made. The tones are determined by plug-in modules. Write to *Alpha Electronic Services, 8431 Monroe Ave., Stanton CA 90680.*

Ed Webb W4FQM/1
Technical Editor



The HEATH IB-102 PRESCALER

With the greatly increased activity on 6 and 2m FM the average ham is in dire need of a means for frequency measurement above 30 MHz. The Heath Company had a nice 15 MHz counter (the IB-101) well within the normal ham's equipment budget. But a method or device was needed to allow their 15 MHz counter to measure to better than 150 MHz. To fill this need Heath introduced the IB-102 prescaler. This unit will take a 150 MHz signal and divide it by 10 and thus allow the counter to read it as a 15 MHz signal.

The Heath IB-102 prescaler is enclosed in the same attractive case as their counter. The unit is all solid state of course, using both FET and bipolar transistors plus TTL integrated circuits. With Heath's excellent instructions and assembly manual the kit goes together in four or five evenings of work.

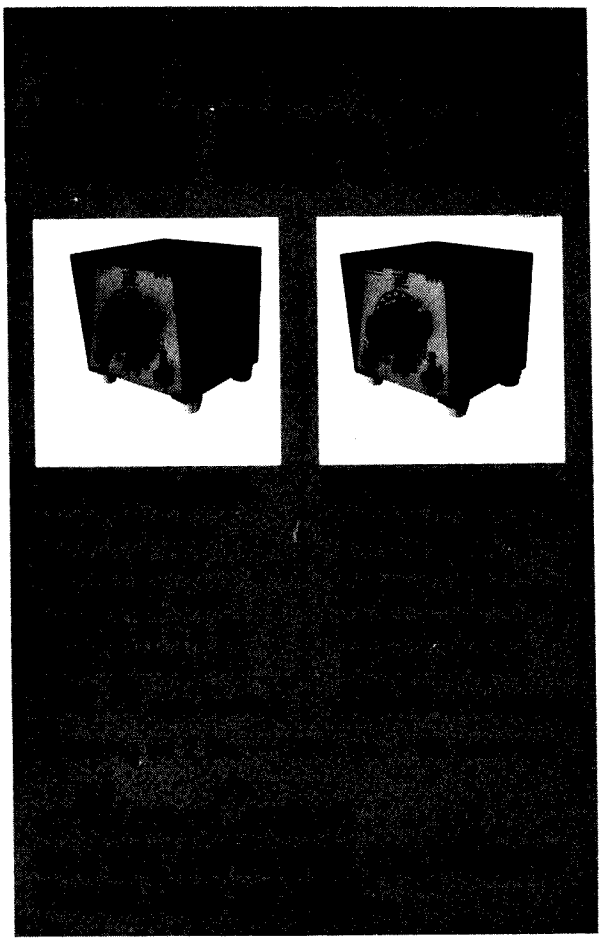
The 50Ω input to the IB-102 is fed to a broad band amplifier. This amplifier in turn feeds an IC that functions both as a trigger circuit and as a level translator to get the input signal to the proper TTL switching levels. The output of the trigger circuit is fed to a second IC that provides a divide by 2 function. The divide by 2 stage is followed by an IC divide by 5 stage for a total division of 10. An additional IC decode (divide by 10) stage can be switched in to give a divide by 100 as well as a divide by 10 function. The output from the various divide stages is fed to an output buffer amplifier This gives the proper impedance transformation from the relatively low impedance used in the ICs to a high impedance output that will match the high impedance input of a frequency counter. Provisions are also made to operate the scaler "straight-through" when the divide by 1 function is selected.

The Heath IB-102 offers several important features not found on any of the other prescalers offered on the ham market.

First: It has an imput level meter so that you know that the prescaler has an adequate input signal level for proper operation. No more do you have to adjust the input coupling to the prescaler and see if your counter reading changes. The meter tells you the whole story.

Second: The IB-102 has an input sensitivity control on the front panel so you can adjust the input broadband amplifier gain to keep the input level meter in the green area. There is even an input test button on the front panel. If you push it (with a signal applied to the prescaler) and the input meter stays the same, you have enough input gain. If the meter level changes you need to adjust the input gain control or provide more input to the prescaler.

Third: The IB-102 is the only prescaler to have a divide by 100 function. This doesn't mean much to you if you have a 15MHz counter and thus can use the divide by 10 function to read 2 meter signals. BUT if you are one of those who has one of those surplus 2 MHz or 10 MHz counters from MARS, the divide by 100 function saves the day – you too can read 2 meter signals. True, you lose a significant figure on the right and thus only read to the nearest 100 Hz with a 1 second gate time. But on most of those counters you also have a 10 second gate time. By using 10 second, you regain your lost digit and read to the nearest 10 Hz!



The input sensitivity for 2 meter work is excellent. A 90° right angle BNC connector was put on the input jack. A little 19 inch whip antenna was fitted to a male BNC connector and that in turn was plugged in the right angle connector. Now the prescaler was all set with a 1/4 wave 2 meter vertical antenna. No trouble was encountered in getting the input meter "in the green" and good counter readings from a 2W hand-held 2 meter transceiver across the room. Even mobiles pulling up in the driveway 15 feet away could be read.

Once again the Heath Company has seen the ham's need and has zeroed in on the problem. Result: a new product that exactly fills the need and is less than $100. That's a hard act to follow. The IB-102 is a most satisfactory piece of test gear and should be a companion to the counter in your lab. It lets you accurately measure frequencies that you could only guess about before. With the IB-102 available, there's no excuse for being off frequency whether it be on FM or moonbounce or one of the MARS VHF channels.

...W4FQM/1

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Patent Applied For.

3 Watt Audio Amp.
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4. Tests indicate less cross talk.

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1. Free typical FIAM Receiver Adaptation details. Postage ..... $ .10
2. FIAM Construction & Operation Manual. (Postage Included) ..... $ 1.25
3. 2 Modulation Control units. 36.95
4. Postage & H.C. for item 3 ..... .50
5. Additional components (purchased from others). 40.00

MARS

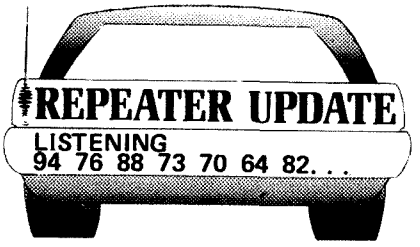
From your response to earlier MARS articles, two things are obvious: If you are already a MARS member, this column is old-hat—you are familiar with the operation, the meetings, the awards, etc. If you are a non-member, such news items are of no great interest—more importantly, you want to know what MARS membership could mean to you. Therefore, in the future, I will concentrate on the MARS story, its purposes, plans and aims, and how you can broaden your horizons and profit greatly as a result of your membership.

Consider, if you will, an organization of thousands of dedicated hams, all using the same procedure, the same format, the same phonetics for a given letter of the alphabet—and all bound together by a common interest, military communications. Generally, hams are a friendly lot, by nature of their hobby. MARS membership embellishes this friendship—members become close friends through their association day after day on MARS frequencies, constantly adding the newer members to their own individual circle of friends and acquaintances. Example: Third US Army MARS instituted the "buddy" system several years ago. A new member is assigned a "buddy"—an older member who lives nearby—to help the neophyte get on the air, or to answer any questions concerning the MARS operation.

To reiterate, you don't become a MARS member *instead* of becoming a ham—you become a MARS member *because* you are a ham! The basic requirements are: a valid amateur radio license (yes, you can join as a Novice or Technician); at least sixteen years of age; an interest in military radio communications; equipment capable of operation on the frequencies to which you will be assigned—in most cases just outside the eighty or forty meter bands. To become more familiar with the MARS operation, you might like to listen to some of the Nets. Try 6997.5 kHz, 7305 kHz, 7358 kHz, 7360 kHz and 14,405 kHz in the daytime. During the early evening hours listen on 4001.5 kHz, 4010 kHz, 4015 kHz, 4020 kHz, 4025 kHz and 4030 kHz. WAR Broadcasts, consisting of approximately 200 words, are transmitted Mondays at 8 PM Eastern Time on 3347 kHz, 6997.5 kHz and 14,405 kHz at 15, 20 and 25 words per minute. Such transmissions are good code practice opportunities.

If you are equipped to copy Teletype, the same message is transmitted on the same frequencies on Tuesday evenings at 8 PM Eastern. Army MARS stations use the prefixes A, AA, AD or AL before their usual district number and final letters, i.e.: W4SCF is A4SCF in Army MARS. Air Force MARS stations are identified by AF prefixes, while the Navy MARS program utilizes N prefixes. A brochure outlining the MARS operation will be sent to those who are interested. For the brochure, for MARS applications for any branch, or for any information concerning MARS, simply address:

Harry Simpson
MARS Editor
73 Magazine
Peterborough, N.H. 03458



NC	K4RUQ	Durham	34–94
NC	K4ITL	Raleigh	28–88
NC	K4RSH	Chapel Hill	22–82
NC	WB4QEP	Danville	28–88
NC	K4VUG	High Point	34–94
NC	WA4OFF	Greensboro	16–76
NC	W4EVU	Salsbury	28–88
NC	WB4PPS	Roaring Gap	22–82
NC	W4PAR	Lexington	31–91
NC	WA4CQK	Mount Airy	38–98
NC	W4BFB	Charlotte	34–94
NC	W4NYR	Shelby	28–88
NC	WA4NUO	Ashville	34–94
NC	WA4BVW	Mt. Pisgah	16–76
TN	W4TEA	Knoxville	16–76
ENGLAND			
	GB3PI	London	145.15–145.75

FM REPEATERS IN ENGLAND

A "UK FM Group" has been formed to press for permission to establish FM repeaters in the UK. So far, such repeaters are not allowed by the authorities. The following are some FM channels (simplex) in common use in the UK:

144.350 Calling channel, Southwest and South Wales area
144.400 Working channel for above area
144.480 Calling channel, London area
144.600 RTTY and FM working channel but RTTY priority
144.800 Working channel matching above calling channel
145.000 Mobile calling channel
145.150 Calling channel (little used at present)
145.200 Working channel matching above calling channel

W2EEY

ARE YOU TAKING 2 METERS TO HAWAII?

Hawaii repeaters have been expanded with a view towards better coverage of the islands and better service for the visitor.

146.28/146.88 is now on Diamond Head, giving full coverage of your stay in Waikiki. This repeater, KH6EQF, is linked on 450 to KH6EQK on Mount Haleakala. With its 10,000 foot elevation, KH6EQK gives good coverage on 146.34/146.94 throughout the islands of Maui and Molokai, and coverage on parts of northern Oahu and western Hawaii (The Big Island). Plan on .34/.94 for your island hopping, but you may want .28/.88 in Waikiki unless your hotel room is high and easterly facing Haleakala, 100 miles away.

146.20/146.80 is primary Honolulu frequency, thru a new repeater at Tripler Army Hospital. There are over a hundred users on this repeater. Consider this pair if you plan an extended stay.

146.16/146.76 is a local-area frequency. One repeater, KH6FOX, is located at the University of Hawaii, with coverage into Waikiki. Another, KH6EQL, is located in north-central Oahu at Waialua. A third, KH6EQN, is under construction at 8,000 feet in the Hilo area on the Big Island, with plans for a link to reach the Haleakala -Diamond Head complex. These three local repeaters, all on 146.16/146.76, are lightly loaded and serve as escape routes when the big ones are busy.

There are no tone-access requirements on Hawaii repeaters.

Hawaii amateurs welcome ham visitors, and hope that this explanation, more extensive than is possible in the various charts, will help you to turn up in Hawaii with the right fistfull of crystals.

New Product

100 MHz COUNTER KIT

Heath Company has introduced the IB-1101 Frequency Counter with a 1 Hz to over 100 MHz range and a list of features before now unheard of in low-cost counters. The Heathkit IB-1101 has an input circuit that will accept input levels from less than 50 mV to more than 200V, depending on frequency. The full five-digit readout can be expanded to eight-digit capability by simply using the overrange circuitry. And to make accurate readout even easier, the decimal point is automatically placed with range selection, while MHz, kHz, overrange and gating are indicated by front-panel lights. A one megohm input impedance and low input capacitance reduce the chance of circuit loading.

Priced at just $269.95, the IB-1101 can be assembled in 10 hours. The 26 digital ICs and five cold-cathode readout tubes plug into individual sockets. All other components mount neatly on one double-sided circuit board. For further information write *Heath Company, Benton Harbor MI 49022.*

Caveat Emptor?

Price – $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor . . .

ATTENTION REPEATER OWNERS If you are interested in joining other repeaters via 10 meter DX inter-tie, contact Keith W7DXX/1 at 73.

SELL: HEATH HW-32A ac & dc power supply, EV 664 desk mike, Shure 414 mobile mike, HM-11 SWR bridge. No reasonable offer refused. C Novak, 110-48 72 Ave. Forest Hills, NY 11375.

NO QRN Wyoming ranch land, wild horses, antelope, deer. 10 level acres $20 down, $20 month. Mike Gauthier, K6ICS, 9418 E. Florence, Downey CA 90240.

COLLINS MECH FILTERS 455 Z 10 used $3, F 250 A 67 new $2.50. Want tuner assy. for TS-497 Sig. Gen. state condition and price. WB6IQS, PO Box 4255 Palm Springs, CA 92262.

HAMFESTERS 38th Hamfest and Picnic Sunday, August 13, 1972, Santa Fe Park, 91st and Wolf Roads, Willow Springs, Illinois, Southwest of Chicago. Exhibits for OM's and XYL's, famous Swappers Row. Information and tickets, Joseph W. Poradyla, WA9IWU, 5701 S. California Ave. Chicago IL 60629.

HEATH HW100 HPZ3A SSB/CW filters, with front panel switching. Recently factory aligned, $285. Pickup sale preferred. Dave Lambert, WA1JSD, RFD 3, Derry NH 03038 (603) 432-8194.

100 WATT RF AMPLIFIER Model AKT-7 RF Amplifier will run 100 watts input to an Amperex 5894. In like new condition, still in original military packing. Tunes 200 to 400 MHz as is, can be converted to 2 meter FM amplifier or used as 220 MHz FM Amplifier. Recent issue (1962), $20.00 shipped prepaid. Enclose SASE for copy of schematic and 4 page list of other goodies. Richard Solomon, 19 Pierce Road, Watertown, MA.02172.

FM HAMFEST Sunday August 6 Steuben Co. 4-H Fairgrounds near Angola, Ind. Large flea market, gate prizes – 1st prize an HT220. Picnic grounds, campsites, boating, swimming, food, soft drinks available. Entertainment for SYL. No vendors fee. For more information write FWRA Box 6022 Fort Wayne, Ind. 46806.

VHF NOISE BLANKER Models available for VHF transceiver and receiver-converter systems. See advertisement in July issue 73. WESTCOM ENGINEERING Box 1020, Escondido, CA 92025

YOUR CALL LETTERS Two sets, for windshield and rear glass. Smart white letters with red outline. Easily installed pressure sensitive decals. $1.00, postage paid, anywhere. Satisfaction guaranteed. Lake Jordan Artists, Slapout AL 36092

QST MAGS OCTOBER 1916 TO PRESENT also many other mags and handbooks. Want to sell out everything. Best offer. Sase for list. W6AG 213-786-1214

INFRARED INTRUSION Detector kits. Transmitter: $24.00, Receiver: $22.00. Kits include board, board-mounted components, emitter/detector. See March Popular Electronics. H. Olson, PO Box 339, Menlo Park, CA 94025.

FOR SALE Heath SB-610 Scope. 3 months old $85. Johnson 6 N2 VFO $35. Jim Gysan 53 Lothrop St. Beverly MA 01915 (617) 922-3850.

FOR SALE: HEATHKIT compact kilowatt HA-14 linear, good condition, and homebrew power supply. $110. W2KPE 147-11 76th Ave., Flushing NY 11367.

THREE CHANNEL HANDIE-TALKIE complete with crystals for 04-64, 16-76, and 94-94. Also includes desk stand charger and nicad battery. $315 value. Brand new. First check for $250 gets the whole package. Under manufacturer's warrantee. Radio Bookshop, Peterborough, NH 03458.

CLEANING OUT SHACK garage and attic. Six new surplus 6C21 Triodes, misc. XMfr's, chokes, caps & xtals. List available. WA7OTN, 185 E. 550 N., Bountiful UT 84010.

FM IC-20 & REGENCY – 2A OWNERS Now available, 4 frequency tone burst oscillator, internally mounted. $29.50. Bob Brunkow 15112 S.E. 44th Bellevue, WA 98006. Phone: 206-747-8421.

COMPUTER SHACKSIGNS printed on computer paper, block letters by IBM-1130. Beautiful! Frame it! Call alone, or anything. 13½" x 11", 2 for $1.00. WA2BCY, Lambert, 240 Garth Road, Scarsdale NY 10583.

SALE – LIKE NEW with original instruction book (3) art 13 autotune aircraft transmitters with all tubes, $50.00 each. Also: (3) new panadapters, BC 1031 with spare tubes and power cord and original tech. manual. $70.00 each. Shipping costs collect. W3RYJ, RD 4, Box 368, Reading, PA 19606.

FIGHT TVI with the R.S.O. Low Pass Filter. See p115, March 1972, *73*. Write for brochure. Taylor Communications Manufacturing Company, Box 126, Agincourt, Ontario, Canada.

WARREN, OHIO ARA's Family Hamfest, August 20. Giant fleamart, swimming, picnicking, all free. Displays, mobile checkin. Camping available. Yankeee Lake, Rt. 7 near I-80. Details: QSL W8VTD.

IRCC PICNIC/HAMFEST Try it! You'll like it! July 9, Fairgrounds, Lafayette, Advance $1.50, Gate $2.00. Order: SASE to W9YIP, 477 Robinson, West Lafayette, IN 47906.

EARLY VACATION Then tear up that ticket to Tahiti. There'll be more fun at the ARRL Hudson Division Convention, October 21-22, Hilton Motor Inn, Tarrytown, NY. Exhibits, lectures, 2 meter FM, RTTY, contests, gabfests, New York sightseeing. Fun! No charge for a suntan. For information write Dave Popkin, WA2CCF, 303 Tenafly Road, Englewood NJ 07631.

WANTED 10 meter FM base station. Contact Keith W7DXX/1 at *73* Magazine.

FLASH
EUROPE ORGANIZES FM WITH 600 kHz SPLIT

Just got a telephone call from Kris Partridge, G8AUU in London. He says Region 1 had a meeting in The Hague May 15-19 and they made the big decisions for FM. As to how the decisions will affect FM in England, they have set up 33 repeater channels. There are 1 through 33 covering 145 to 146 MHz. Starting at 145.025 each channel is in 25 kHz steps to 145.825. Channels 1 through 9 are repeater inputs, channels 10 through 19 have not been allocated, and channels 20 through 33 are repeater outputs. Power is limited to 15 watts erp and the deviation in narrow band. (In England wideband is 5 kHz and narrow band is 3 kHz.) Also, tone burst of 1750 Hz is required. The first repeater on the air will be GB3PI in London with the input on channel 6 and the output on 145.750. 145.000 is the national simplex frequency. We will have full details next month.

. . .W7DXX/1

Center Tap a Pot With Silver Paint

After several hours of a Saturday morning were spent trying in vain to locate a 100K center tapped linear pot in local stores, it was decided to try another tack. A regular 100K linear pot and a bottle of silver conductive paint were bought. The paint is the type sold for the purpose of repairing damaged circuit boards and while not cheap, it does have a myriad of uses and will last a long time.

The rear cover of the pot was removed and a careful calculation made as to the exact center of the resistance element. (Translation: I eyeballed it and dobbed the paint in what looked like the center) The stripe of silver was continued across the phenolic to the nearest point of the brass shaft bushing which served to attach the pot to the panel. Success! It worked exactly as planned. Please note that in the example cited the center tap was to be grounded. In circuits in which the tap is above ground other arrangements would need to be made. Perhaps a notch cut in the back cover to clear a wire which could be glued to the phenolic and the conductive paint connected to the bare end.

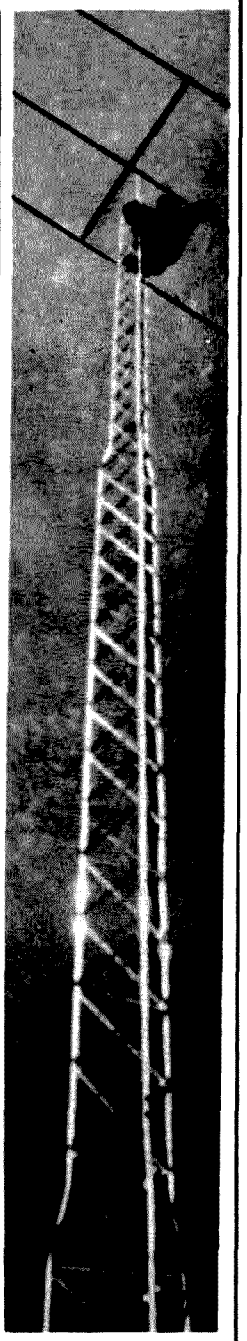
The left over paint will be useful to put in connections on PC boards which were forgotten before etching or required by later redesign in addition to its intended purpose.

William Turner WAØABI

WANTED
R5 CALIBRATION MANUALS NAV 16-30/ARC 38-50 FCR C1398/ARC-38
TALLEN CO. INC., 300 7th St., BROOKLYN, N.Y. 11215

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INOUE IC-21, mobile/base unit with AC/DC supply, 24 ch., SWR & Disc. meter, RIT, Calib., mike. $335.00
Customer servicing & warranty inc. Many Xtals avail.
Tone Burst-4 freq. for IC20 & 21, internal mounting. $29.50
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Eric Falkof K1NUN
Assistant Editor



VHF SPECIALISTS FM-10-50 amplfier

VHF Specialists of Vienna, Virginia, a relative newcomer to the amateur market, has introduced the new 2 meter class C amplifier for FM work. The new unit has been designated Model FM-10-50. The amplifier is somewhat unusual as it utilizes modular type of construction. This technique allows the manufacturer a large degree of flexibility in that different modules may be used to form many different amplifiers with various input and output power levels. The FM-10-50 is a two stage type of class C amplifier using Balanced Emitter Transistor in both stages. The BET type of device can withstand almost infinite VSWR and yet remain undamaged. This is an important factor should you have a broken antenna or shorted feedline. Each amplifier stage is mounted on its own small glass epoxy (G-10) printed circuit board. The two p.c. boards are then mounted side by side in the cabinet and electrically coupled together. The input amplifier or driver stage p.c. board also contains an rf sensing circuit and dc amplifier that functions as a relay drive. The relay being driven is a double type of TR relay on a DPDT form. In the receive mode the relay contacts are connected to allow the signal coming from the antenna to bypass the amplifier on their way to the transceiver. In the transmit mode when the transceiver is keyed the rf sensing circuit pulls in the TR relay thus switching the amplifier in between the transceiver and the antenna. When the transceiver mike button is released the amplifier is once again automatically bypassed for receiving.

In actual testing the FM-10-50 would respond to input power levels as low as 1W while producing 22W output at 13.6V dc. 10W in yielded 42W out and 15W input produced 54W output.

While quadrupling your transmitter power doesn't actually double your range (except in theory) it does do a lot to fill in those "not so hot spots" that you are noisy into the repeater each time you go there. It extends your "outer limits" to usable coverage area where you can put a decent signal into the repeater for as far as you can hear it pretty well full quieting.

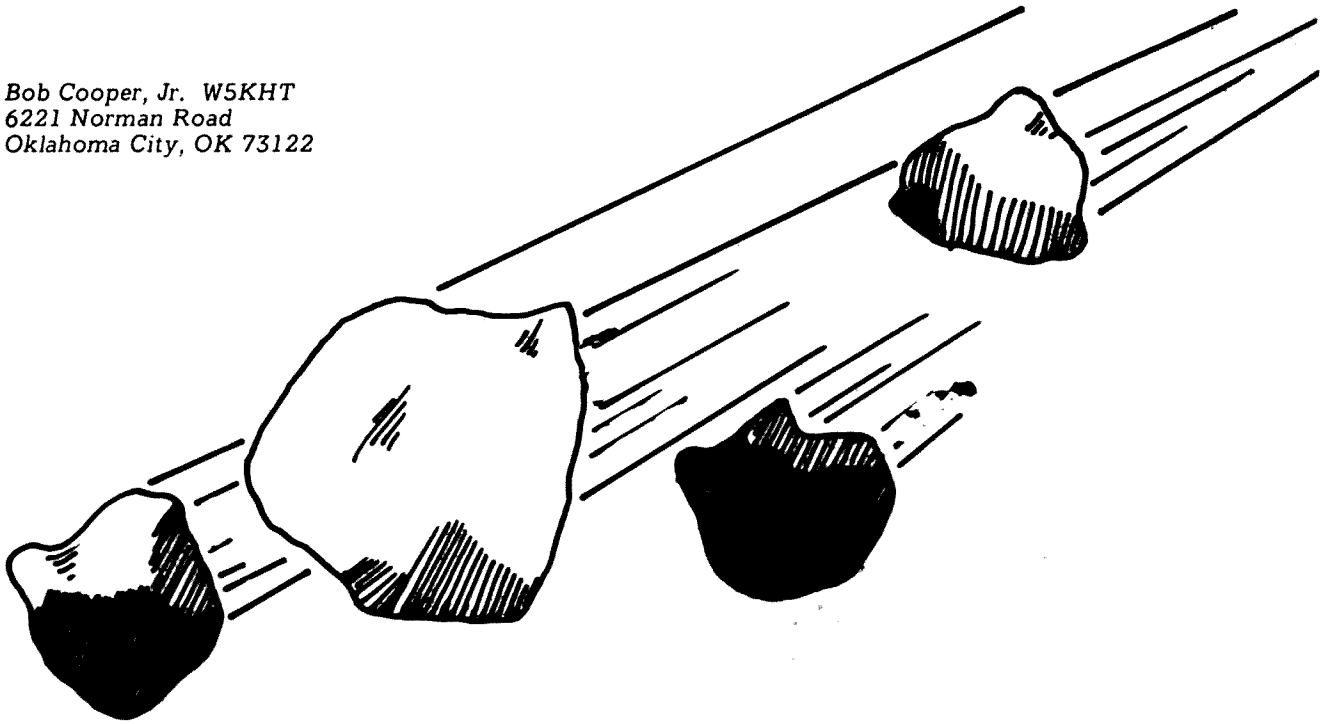
It is an interesting point to note that the VHF Specialists FM-10-50 also uses 100% all-American parts throughout. America is the unquestioned leader in rf power transistors as evidenced by the fact that all four manufacturers of 2 meter class C power amplifiers have stuck to all-American parts and active devices.

The FM-10-50 is mounted in an aluminum case with a top mounted heat sink that is common to both stages. Installation is simple: connect to 12V dc and connect to your 2 meter rig and antenna. No tune-up is required.

. . .K1NUN

VHF Specialists, P.O. Box 167, Vienna VA 22180.

Bob Cooper, Jr. W5KHT
6221 Norman Road
Oklahoma City, OK 73122



Meteor Showers:
NEW ROLE IN VHF DXING?

More frequent than you might guess, meteor showers can provide some interesting DX possibilities — but the key is in taking the proper advantage. Here are some hints and a lot of new data. . .

Nearly twenty years have passed since the first amateur use of meteors on 144 MHz, but strangely enough our apparent understanding of the mechanism is still quite cloudy, and our techniques for use of this propagation mode haven't changed much.

Basically, communication via ionized meteor columns is closely akin to sporadic E skip; only the duration is so short as to force users of this medium into a set of rigidly timed transmitting and receiving sequences if a contact is to result.

Unfortunately, the E layer of the ionosphere (extending from an average minimum height of 45 miles to an average maximum height of 85 miles above the surface of the earth) is still very much a mystery to us, in spite of various scientific studies.

Techniques Utilized

Nearly all amateur radio work with meteors above 50 MHz occurs on 144 MHz, and during periods of the year when *meteor showers* are forecast. Even within the shower periods, schedules are maintained (as a rule) only during those time slots when peak meteor activity is forecast Effectively, this precludes amateur (radio) observations during the other 99 percent of the year – periods during which we know only that meteor activity is not *forecast* to be exceptional. In effect, our cur-

rent use of meteors on 2 meters skims only the top from the year's meteor crop, leaving the rest unobserved and unmeasured.

Additionally, the amateur's use of meteors has been for the sole purpose of gathering new states for 144 MHz DX chasers, and once a contact has been made, seldom is repeat work attempted.

Thus we have a built-in situation where we annually return at the same time, over the same or similar paths and reverify what we have known for as far back as 15 years, seldom attempting to seek out new information.

In the spring of 1969 I made a crude study of meteor column reflection. I chose to monitor for meteor skip on three separated frequencies, essentially over a two-octave range, utilizing commercial signal sources. Channel 7 video (175.25 MHz), FM broadcast band (93.7 MHz), and channel 2 video (55.25 MHz) were simultaneously monitored and, where practical, recorded. The monitoring system in use during the one-year period was basically as shown in Fig. 1.

The main areas of interest during this study were as follows:

(1) Determine the relative frequency of bursts encountered at each of these three (low, mid, upper) VHF regions.

(2) Determine the correlation, if any, between bursts in one frequency region and either or both of the other two regions.

(3) Measure the hourly, daily, and monthly burst *counts* (where possible) *within* each frequency region (and overall for all three regions).

Note: "Bursts" as used herein, refer to receptions of 1–2 sec. "Pings" are shorter, "superbursts" longer in duration.

Amateur experience at 50, 144, and 220 MHz indicated that the *random* meteors produce sufficent ionization for CW (or SSB) communication on 50 MHz virtually any morning of the year in the 0500–0800 period over paths of 400 to 1200 miles. At 144 MHz, CW exchanges can be demonstrated by well equipped, properly manned stations equally as often, although most of the exchanges would not qualify as a contact. Limited work at 220 MHz indicates that random morning exchanges are unlikely, but not completely ruled out. WØDRL, incidentally, has demonstrated that exchanges on 432 MHz are possible during dense shower periods, with contacts

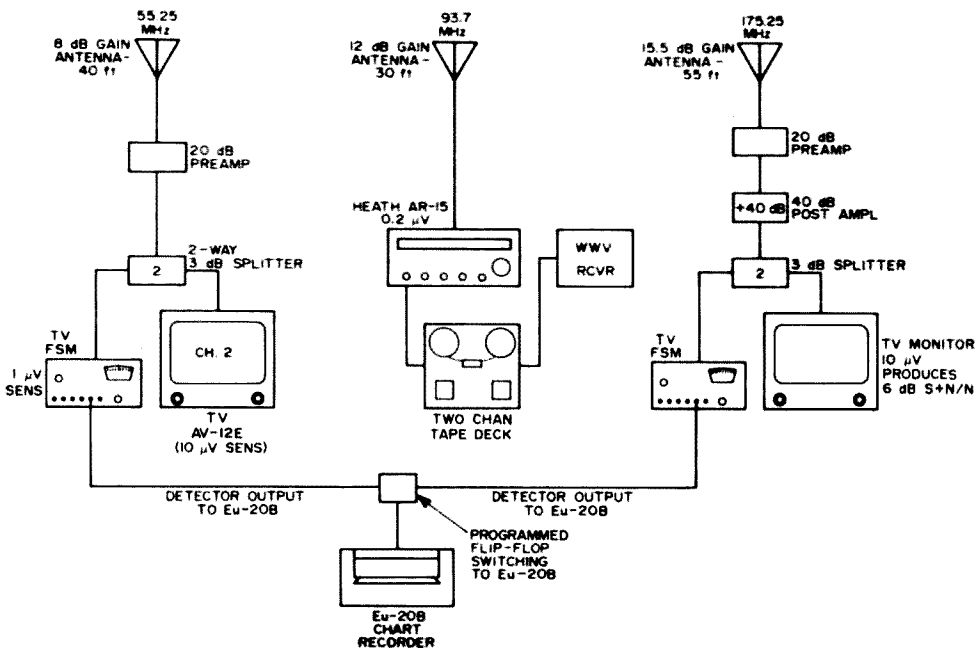


Fig. 1. Equipment set up for year-long, three-frequency monitor experiment.

sure to follow as techniques are improved.

Basic Mechanism

Space debris, consisting mostly of fine particles of dust and small rock, is scattered throughout the solar system (and probably the galaxy) in a semirandom state. If the entire solar system is measured for space debris concentration, over the billions of cubic miles contained therein, the debris would appear to be quite evenly distributed. However, if a relatively small area (such as a million square miles) is studied, a less even distribution of the debris becomes evident. And as we confine our study area to even smaller regions, *substantial* variances in the seemingly even distribution of the debris become apparent.

This bunching of debris is quite well known, manifesting itself (from our earth-bound vantage point) as *regularly scheduled* meteor showers.

Not so well known is the fact that during nonshower periods the number of meteor particles swept up by the earth is also subject to considerable variation. From tables of visual observations during the 3–4 a.m. (local standard time) period, radio meteor activity in the 5–7 a.m. period can be quite accurately predicted. This has been verified by a number of observers.

This space debris which travels throughout our solar system may travel in our own *plane*, in an adjacent plane, or in a plane that is *tilted* (with respect to the earth revolving around the sun). We may encounter the same debris region each year, in our revolving about the sun, or less often than annually.

All studies of meteor debris made from the earth began as visual studies, and were therefore limited to those periods of the day when there was local darkness and clear skies. Radar returns from ionized meteor columns have evolved as a minor research program by a number of university programs, and this has helped to fill in the important time gap when the sky is not dark or clear enough for observation. (This is especially important in the summer period when daylight is longer, the peak period of the year for meteor activity.)

As the earth revolves about the sun, it is also rotating on its own axis. As Fig. 2 shows, the leading side of the earth (the side facing into the direction of the earth's travel through space and around the sun) is

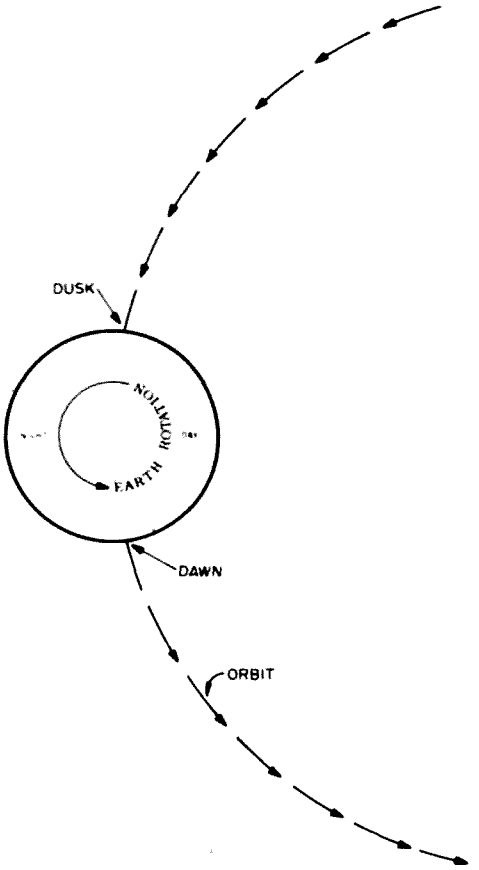


Fig. 2. Sketch shows direction of earth travel and rotation with respect to sun.

at the 6 a.m. (earth time) point. And the 6 p.m. point (the opposite side) is directly behind the earth's leading edge. As the earth travels through space, it overtakes slower-moving space debris caught ahead of it. Captured by the earth's gravitational field, the debris is pulled toward earth. At the same time, space debris moving in essentially opposite directions to the earth's movement is met head-on. The earth literally runs down much of the debris caught in its path, and unless deflected away from a true course, this debris is drawn directly into the E layer.

The density of gaseous particles in the upper layers of our ionosphere is quite well known. The density of the F layer, for example, is considerably lower than the density of the E layer.

The speed of the debris particle (which is dependent upon its original trajectory before it was caught by earth gravity) determines to a large measure the friction between the particle and the gaseous contents of the E layer. As the particle is drawn closer to the earth's surface (lower and lower in the E layer), it encounters denser gaseous materials, increasing the friction on the surface of the particle and eventually heating the particle to a temperature sufficent to cause it to ionize a trail of gaseous materials in its wake as it trajects towards the lower reaches of the ionosphere. Eventually the friction heat of the particle is sufficent to cause it to ignite or burn, which produces the familiar shooting star. Visual ignition of the particle is not required for an ionized meteor column to form in the E layer, however.

The ionized column is in actuality a *cone*, and the electron density within this conal region is sufficent to cause refraction of VHF radio signals, much in the same way the regular E and F layers refract lower-frequency signals on a regular and daily basis.

As we can see in Fig. 2, the daybreak period has a natural advantage over other periods of the day because of the relatively greater number of particles which the earth sweeps up during this period.

By the same token, the twilight period is traditionally the slowest period of the day – principally because for any debris to be caught up by the E layer in that period of the day, the debris must either be traveling in the same plane and direction, but at a *greater* speed than the earth, or be

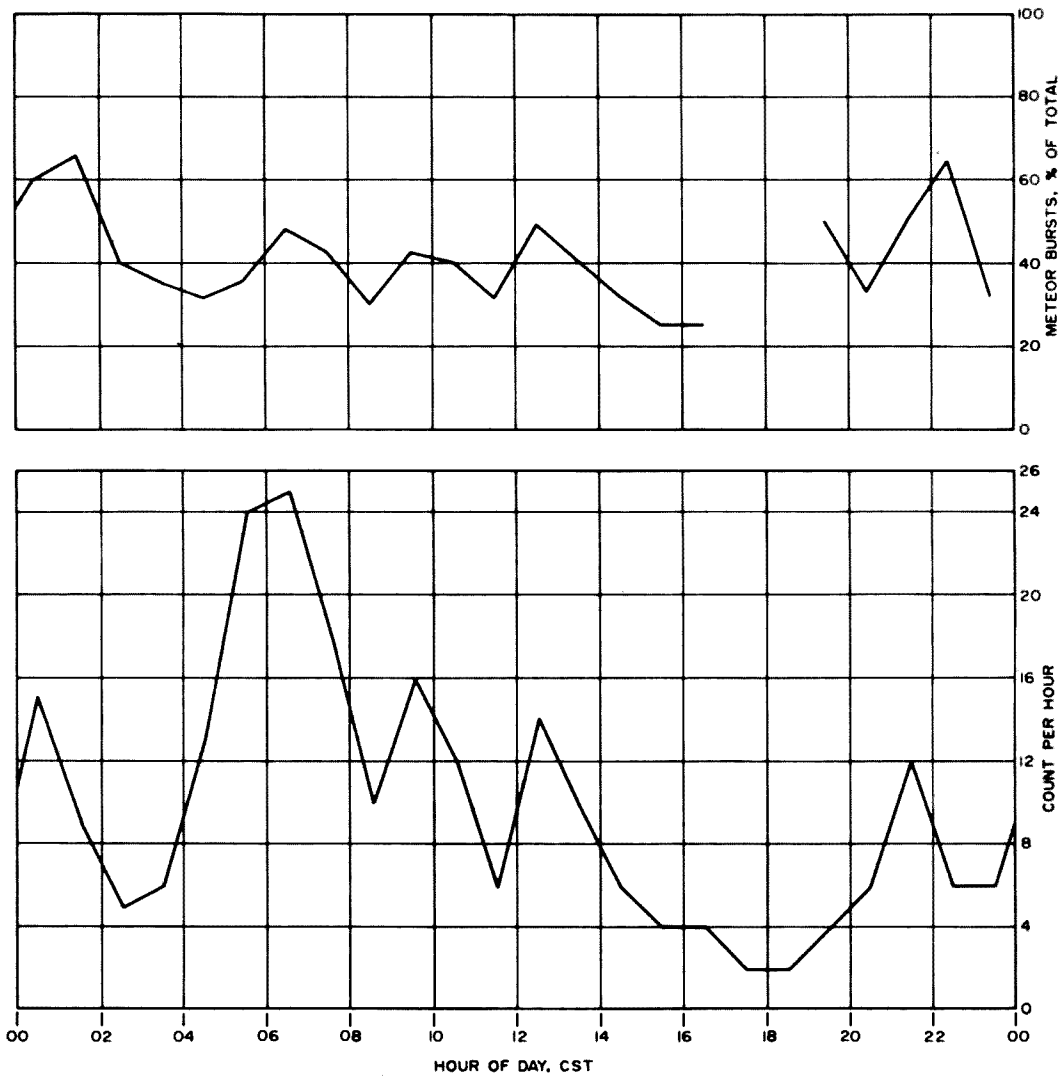


Fig. 3. Average activity, based on 41 day monitoring period (93.7 MHz). The lower portion shows average count of bursts on an hour-by-hour basis; the upper chart lists the percentage of bursts that were greater than 1 second in duration.

traveling in a plane tangent to the earth and at right angles to the earth's plane of movement, passing into the E layer from the side. This happens not very often.

In a scholarly study entitled *Meteors, Meteorites and Comets*, Smith pointed out that radar studies of VHF meteor reflections substantiate the 5–7 a.m. period, *but* noted there were unexplained increases in meteor reflection counts also around 10 a.m. and again around 10 p.m. To this I must also add that based upon my own observations and chart recordings, there are also decided subpeaks in the noon and midnight periods.

My own method of observation is simple to duplicate: The FM receiving system of 93.7 MHz is recorded on a Heath model EU-20B servo chart recorder. The presence of rf carriers (down to 0.1 μV) and their relative strength over a 20 dB range (limit of EU-20B dispersion without a dc log amp), are recorded at a standard speed of 4 in per minute. Simultaneously, a two-track audio recorder preserves the audio information (from the transmitting station) on one channel, while WWV (as a time base) is recorded on a second channel. Time marks are made on the EU-20B chart manually at the beginning and end of each recording session so that additional time marks can be added during analysis.

From the chart of Fig. 3, some conclusions are possible, with the following qualifications:

(1) 93.7 MHz was chosen as an FM reference frequency because it was not occupied in my area, and in the north, east, NE, and SE regions of the country it was well occupied by high-power FM broadcasters. •By plotting the location and coverage areas of stations on this frequency, versus other possible frequencies, it became apparent that this frequency had more territory *covered* with signal than other frequencies I could have chosen.

(2) Many of the stations operating on this frequency did not sign off until after 2 a.m. EST, and returned to the air by 5 a.m. EST, affording me nearly 24-hour coverage.

(3) FM stations on this frequency closely paralleled TV channel 2 and TV channel 7 allocations, which I was also monitoring, affording excellent opportunity for correlation within a single burst over the frequent range 55.25 to 175.25 MHz.

The observations for the 93.7 MHz measurements, in the 41 monitoring periods, were as follows: considerably higher in the 9–10 (a.m. and p.m.) period than in the 5–7 a.m. period. In other words, if a one-hour period (5–6 a.m.) produced 20 pings, 4 bursts, and a single superburst, a sampling of the 9–10 a.m. period for the same date or the 9–10 p.m. period for the evening prior indicates (typically) 5 pings, 5 bursts, and 1 superburst. (The *total* count is *lower*, but the count of *usable* bursts is *by percentage* much higher.)

The same observation can be made for the noon-to-1 p.m. midnight counterperiod. Of all periods in the day, this has proved to be the most uniform. On a day-to-day basis, the counts during these two periods are relatively unchanged (except during shower periods). The ratio of pings to bursts during both of these periods falls into a region around the 5–6 a.m. and 9–10 (a.m./ p.m.) periods.

Briefly, the additional *total count* subpeaks during the day (other than the expected 5–7 a.m. period) can probably be explained by two mechanisms:

The 12–1 periods find the earth's surface directly above the time zones shown in Fig. 4. It is probably that debris particles that escape being drawn into the 5–7 a.m. period are swept in a curved trajectory by the wake of the earth's ionosphere and are caught by the outward extension of the ionosphere (points A and B, Fig. 4). This would suggest that the majority of the particles entering the E layer in this period would follow a west-to-east trajectory, and this would enhance signals to the east (or west) of you with greater frequency than signals to the north or south of you. The bursts and superbursts almost always come

(to my location in Oklahoma) from stations 70–110 degrees from me. (I did not look west during these tests.)

The 9–10 periods are less prone to explanation. Smith offered no explanation, noting only the existence of the increased radar return count.

One of the most plausible theories advanced suggests that particles swept into the 5–7 a.m. time period *at an angle* actually skip (as a flat stone thrown across smooth water) from the upper ionosphere; their speed reduced, they will *precipitate* back under the influence of gravity several time zones hence (see Fig. 4).

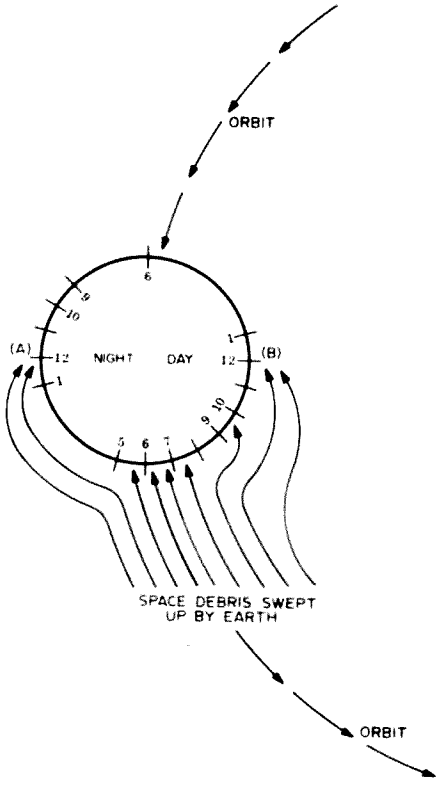


Fig. 4. Path of space debris being intercepted by the earth.

This is borne out to some extent by the observation that at least in the 9–10 a.m. period, there is good correlation on a daily basis between the average total count in the 5–7 a.m. period and the later count in the 9–10 a.m. period for the same day.

The 9–10 p.m. period is more difficult to account for; as Fig. 4 shows, it occurs at a time when the portion of the ionosphere directly over this time zone region is not favorably located for such a skip trajectory, *unless* the skipping is from the midnight period just ahead of it. If such were the case, we would expect a similar situation around 3–4 p.m. as a result of skipping from the noon period. Observations indicate that no such enhancement period exists in the 3–4 p.m. period.

In either case, there is good total-count correlation between the following periods:

(1) 5–7 a.m. and 9–10 a.m. (same date).

(2) 12–1 p.m. and 12–1 a.m. (with 12–1 a.m. time on date following the 12–1 p.m. date).

(3) 9–10 p.m. *seems* to correlate with *both* 5–7 a.m. (5–7 a.m. following) and the midnight period (immediately following); but in both cases the correlation is not good enough to be substantiated.

For directions, the 5–7 a.m. time slot is random. East–west paths propagate just as well as north–south paths.

The 12–1 periods favor basically east–west paths.

The 9–10 periods *seem* skewed in favor of SW–NE paths, in the sense that the *perpendicular* paths (NW–SE) are noticeably poor in these time slots.

Simultaneous Monitoring - 55.25, 93.7, and 175.25 MHz

With relatively similar systems on each of the three frequencies, when the same burst produced propagation on two or more frequencies at the same time, the meteor-propagated signal appeared *first* at the highest frequency affected in 90% of the cases. In other words, if there was propagation at both FM and channel 2, the burst reception appeared first on FM, and was followed by TV up to a full second later (typically just under a second). And if a burst affected all three frequencies, it *always* appeared on 175.25 MHz first, followed up to a second later by the appearance on FM and then up to a second later by the propagation of channel 2 (55.25 MHz). This was directly contrary to

everything we have been led to believe about ionospheric propagation: skip that starts at the top end and works down!

As is often the case with a basic discovery about any physical phenomenon, I was being told something – something very important about the mechanics of the actual formation of an ionized meteor column and the refraction that takes place within the column.

As long as the meteorite particle remains intact its trajectory is marked by an ionized trail spreading behind it.

From the analysis of several hundred recordings of bursts, these factors become apparent:

- At 175.25 MHz, the most intense signals come at the beginning of the burst (Fig. 6), with a trailing off behind the initial peak.

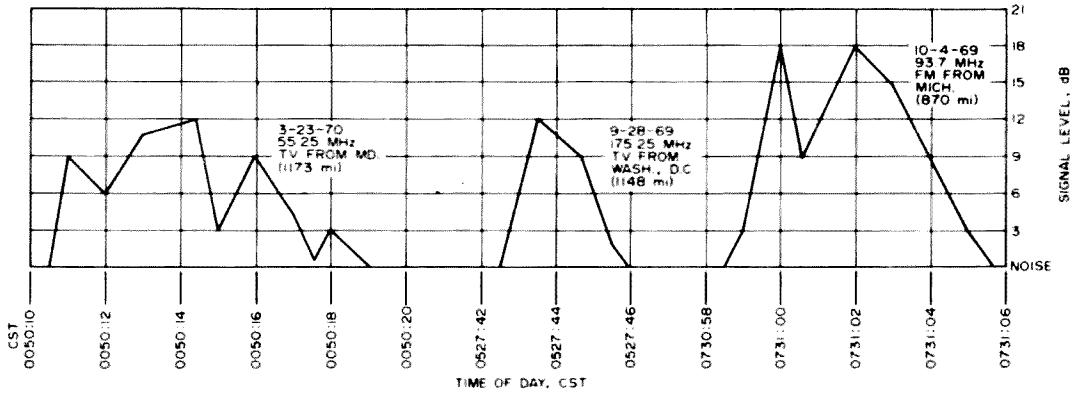


Fig. 6. These curves show the typical duration of meteoric signal reflection. Note the correlation between duration of activity and frequency of occurrence.

Let's look at the mechanics of a meteor-ionized cone formation, in Fig. 5. Here we see that the diameter of the ionized "cone" trail left behind the meteor trajectory is smallest at the particle itself, but it flares outward behind the particle much in the way a speedboat wake flares.

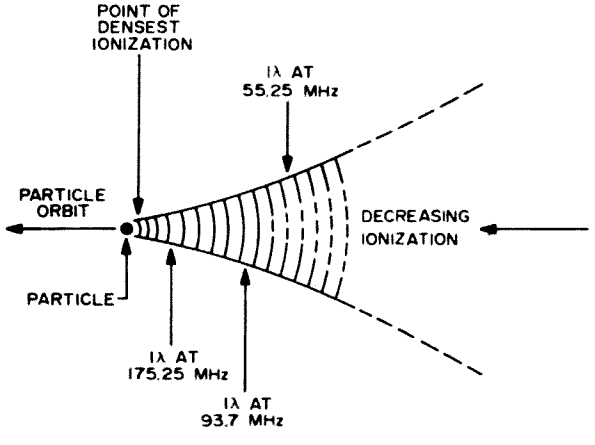


Fig. 5. Bursts are noticed on the higher frequencies first. This could be attributable to the conical makeup of the ionized trail of the meteoric particles.

- At 93.7 MHz, there is often a double-humped initial-signal peak, followed by a depression, followed by a second equally strong peak (Fig. 6).
- At 55.25 MHz, the initial peak is often not the strongest one (although the variation in patterns is greatest at this lowest of observed frequencies).

The intensity of the electron density is going to be greatest in the region *directly* behind the particles (Fig. 5). The amount of ionized material present is most concentrated at this point, dispersing over a wider area as the cone flares.

On the assumption that the density is sufficent to cause signal refraction at 175.25 MHz, refraction will begin to occur only when the 175.25 MHz signal encounters a region within the cone where the cone's flare is at least one wavelength wide (and the electron density at that point in the flare is sufficent to support 175.25 MHz propagation). Because the total *length* of the intense portion of the ionized column is generally short, this point occurs before the conic region has

flared to a sufficent width to propagate the lower frequencies. And the same is true with the 55.25 MHz signal: the cone has flared to a sufficient (one wavelength) width at 93.7 MHz before it has flared to a one wavelength width at 55.25 MHz. (Note that width of the cone and length of the cone can be interchanged here with no basic change in the postulation.)

Keep in mind that maximum frequency propagated is directly related to electron density within the conic area, and that electron density is in turn a function of particle size, speed, and the level within the E layer that the particle ignites.

As Fig. 7 shows, the total burst length, for a burst affecting all three of the monitor frequencies employed here, is pretty much textbook. The highest frequency starts and stops first (lasting the shortest total time); the median frequency starts and stops second and lasts the median amount of time; and the lowest frequency starts last, lasts longest, and quits last.

For the 144 MHz meteor DX'er, this plainly suggests that a whole new school of operating techniques is in order, built around a crystal-controlled converter and a channel 7 (or 8 or 9) TV yagi, using the appearance of bursts at these frequencies as the tipoff to an "opening."

Finally, it should be reported that the frequency of bursts between 55.25, 93.7, and 175.25 MHz drops off substantially, as would be expected, as we go higher in frequency. This dropoff in total count (pings, bursts, superbursts) is about what you would expect, and is representative of both shower and nonshower periods:

From hundreds of hours of substantiative observations it appears the average meteor refraction noted at 55.25 MHz is also found up to 93.7 MHz. At some point between 93.7 and 175.25, the average-burst MUF peaks out and does not reach the highest of the three frequencies.

The author would be interested in hearing from others who have studied or would like to study other aspects of meteor propagation.

... W5KHT ■

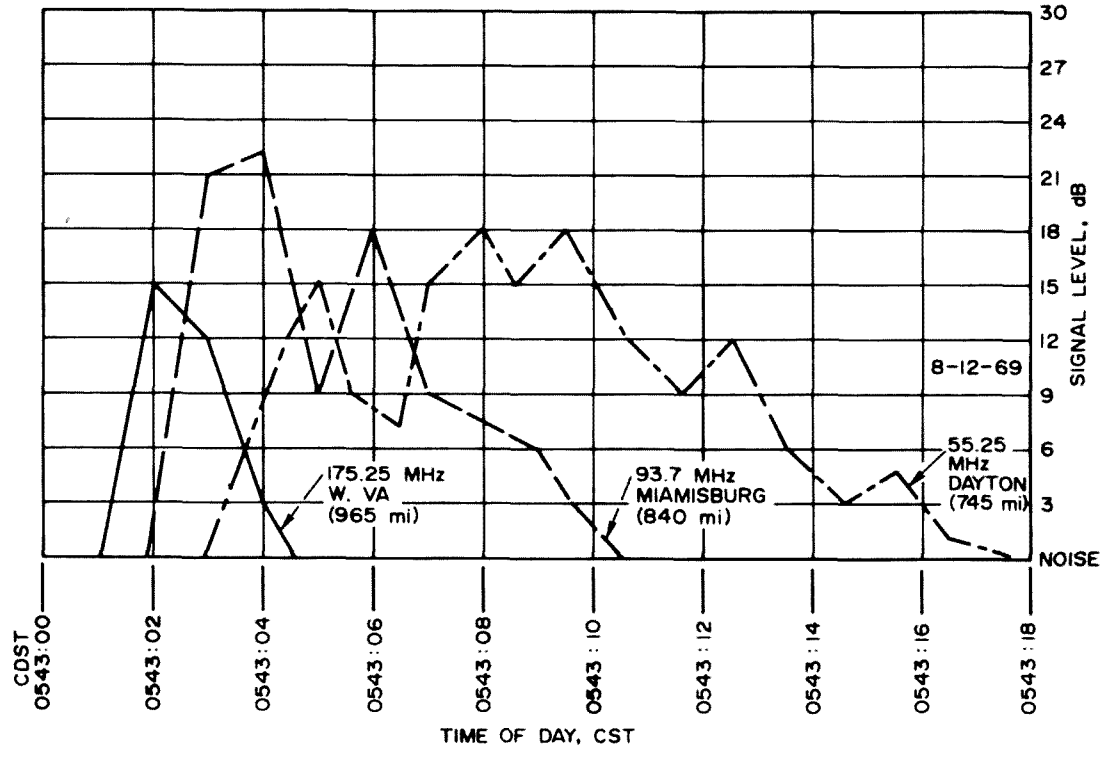


Fig. 7. This composite graph shows burst activity on three frequencies. Note that the highest frequency occurs first, lowest frequency starts last but stays longest.

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741 OP-AMP COR and TONE DECODER CIRCUITS

The integrated circuit COR and tone decoder circuits shown here are both novel. Both use the 741 type operational amplifier as a combination voltage comparator, high gain amplifier and relay driver. As shown in Fig. 1A, the operational amplifier has two input pins, one output pin, a power supply pin, and a ground pin. Some units also have two "offset-null" pins, but since these are needed only in special cases they are not shown.

The 741 type op-amp is available under different numbers from several manufacturers using different case styles as shown in Fig. 1B and Table I. Obviously the 741 op-amp and all its different versions are very popular, and it is often available for under a dollar.

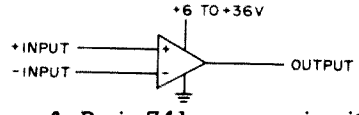
Of the two inputs, the one labeled + is also often called the non-inverting input, meaning that an input signal on this pin is amplified without being inverted (turned upside down.) The input labeled – is called the inverting input and a signal here is inverted at the output. While this description is useful when the op-amp is used as an ac amplifier, there is a better way of describing the operation at dc.

Since the two inputs have opposite effects on the output, applying the *same* input signal to both input pins will cancel out and produce *no output*. In operational amplifier lingo, this is interpreted as meaning that the output is just halfway between the positive voltage supply and the negative voltage terminal. For instance, if the IC is run at +12V, then the output will be halfway between +12V and ground, or at +6V.

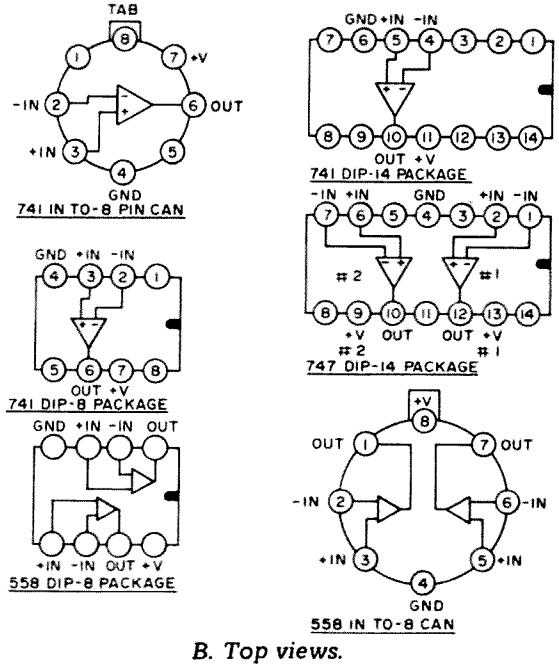
TABLE I

741 type IC Manufacturers and Numbers

Manufacturer	Number	Case & No. Pins
741 Series		
Fairchild	μ5B7741393	TO-8
Fairchild	μ6A7741393	DIP-14
Fairchild	μ9T7741393	DIP-8
Texas Instruments	SN72741J or N	DIP-14
Texas Instruments	SN72741L	TO-5
Texas Instruments	SN72741P	DIP-8
747 Series (two op-amps in one case)		
Fairchild	μ5F7747393	TO-10
Fairchild	μ7A7747393	DIP-14
Texas Instruments	SN72747J or N	DIP-14
558 Series (two op-amps in one case)		
Texas Instruments	SN72558L	TO-8
Texas Instruments	SN72558P	DIP-8
Motorola	MC1558G	TO-8
Motorola	MC1558P	DIP-8
Signetics	N5558T	TO-8
Signetics	N5558V	DIP-8



A. Basic 741 op-amp circuit.



B. Top views.

Fig. 1. The 741 op-amp.

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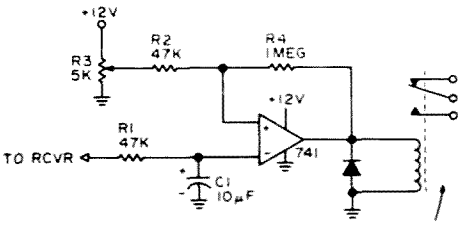


Fig. 2. A COR circuit using the 741 op-amp.

This happens only if the input to both input pins is the same, within a small amount known as the offset. If the plus input is made more positive than the minus input then the output goes more positive. Because of the high gain, only a small difference in inputs is enough to bring the output as high as it can go, within a volt or two of the positive supply voltage.

On the other hand, if the plus input is more negative than the minus input, then the output quickly swings down to within a volt or two of ground. If we connect a relay from the output to ground as in Fig. 2, we can operate that relay by slight changes in the voltages fed to the two op-amp inputs.

The circuit in Fig. 2 is a COR (Carrier Operated Relay) I devised for use with a Vanguard 2m FM receiver. There is a point in this receiver at the output of the audio amplifier which swings from its normal +9V or so down to about +8V when a station is received. I wanted to operate a relay when this voltage dropped.

I simply fed this voltage to the minus input of the op-amp through 47K resistor R1, with capacitor C1 removing any audio. At the same time, the plus input connects through another 47K resistor R2, to the wiper of R3 which provides an adjustable voltage which can be set anywhere between 0V and +12V. For our application we adjust R3 for about 8.5V.

In this application the op-amp acts as a voltage comparator, comparing the voltage from the receiver against the 8.5V reference from R3. With no received signal the receiver provides about 9V, which is higher than the 8.5V reference. Since the minus input to the op-amp is therefore more positive than the plus input, the output voltage is near ground and the relay is off.

As soon as a signal is received, the receiver voltage drops below 8.5V. The plus input is now more positive, and the output goes positive, pulling in the relay.

The circuit would operate quite well without R4, the .1 MΩ resistor from the input back to the plus input, turning on the relay when the input voltage drops below 8.5V and releasing the relay when the input voltage goes back above 8.5V. But occasionally a very weak signal will cause the input voltage to swing back and forth near 8.5V, causing the relay to pull in and out.

To prevent this relay chatter, R4 feeds back a portion of the voltage at the output back to the plus input, increasing the reference voltage fed in from R3 by about 0.2V when the relay is on, and dropping the reference by about 0.2V when the relay is off. This way the relay doesn't go on until the receiver voltage drops below 8.3V. Once on, the relay stays pulled in until the input voltage goes back up to about 8.7V. This hysteresis effect prevents relay chatter on weak signals by changing the circuit into a Schmitt trigger. The dead band can be tightened up by increasing the value of R4, or eliminated by removing R4 entirely.

Another application of the 741 op-amp, again used as a voltage comparator and relay driver, is shown in Fig. 3. Here we have an 1800 Hz tone decoder.

To see how it works, assume first there is no input signal. Resistors R1, R2, and R3 form a voltage divider between +12V and ground, and set up the basic biasing for the circuit. The voltage at the common point between R1 and R2 is about +3.3V. Since this point connects to the minus input of the op-amp through R6 and R5, it provides a

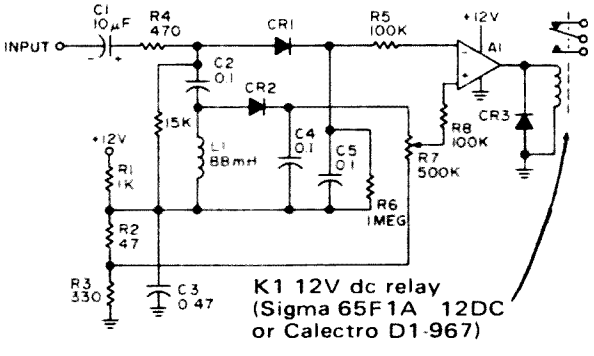


Fig. 3. 1800 Hz decoder.



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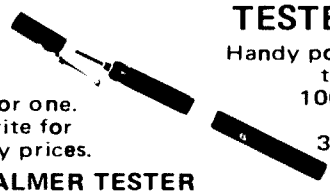
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positive bias to this input. At the same time the voltage at the common point between R2 and R3 is about 0.4V more negative, and this point connects to the plus input of the op-amp through R7 and R8. Since this makes the plus input more negative than the minus input, the output of the op-amp is near ground, and the relay is off (the relay can pull in only if the plus input of the op-amp becomes more positive than the minus input).

Now suppose an audio signal appears at the input terminal. This signal is fed through C1 and R4 to a series tuned circuit consisting of L1 and C2, tuned to 1800 Hz. The audio signal appearing across the *entire* tuned circuit is rectified and filtered by CR1 and C5 and applied to the minus input of the amplifier. Also, the signal across just L1 is tapped off, rectified and filtered by CR2 and C4, and applied to the plus input of the op-amp through level control R7. Both CR1 and CR2 produce positive rectified voltages, but the output from CR2 tries to turn on the amplifier and close the relay, while the output from CR1 tries to keep the relay open.

The tuned circuit does two things at the same time. First, a series tuned circuit at resonance acts as a short circuit, shorting any 1800 Hz signal to ground. Thus it acts as a notch filter, removing 1800 Hz signals from the input to CR1.

But at resonance the current through L1 is quite big, so the voltage across it is high. Thus the tuned circuit selects 1800 Hz signals and sends them to CR2. The total effect of all this is that 1800 Hz signals try to close the relay, while every other signal tries to force the relay open. The relay can only close if there is more 1800 Hz signal than everything else combined. What this really means is that the decoder can't be triggered by noise, speech or even singing – it needs pure 1800 Hz tone.

Potentiometer R7 adjusts the bandwidth, and also affects the sensitivity of the decoder. The proper way to adjust it is to set it for the required bandwidth, and add a separate gain control before the decoder to set sensitivity. Toroid and capacitor tolerances being what they are, you will probably have to try several capacitors to get the

center frequency just right. My C2 capacitance actually measures closer to 0.09 μF than 0.1 μF.

As shown in Table II, the bandwidth is remarkably independent of input level, unlike many decoders which become as broad as a barn when fed with strong signals. If anything, bandwidth becomes a bit smaller at high levels.

The input impedance is about 470Ω and minimum input voltage for reliable operation is between 1 and 2V. Thus the decoder can be bridged across a 4 or 8Ω speaker line, or even across a 500Ω unbalanced line. If the available signal is too low, you can reduce the value of R4, but don't go below about 250Ω. If you need even more sensitivity, use a 3:1 or 10:1 step-up transformer – a filament transformer of the right turns ratio will do just fine.

Don't forget that the decoder won't respond to a tone if it's accompanied by speech or other tones, because anything other than the desired frequency desenses the input. This is a useful feature since it means you won't get false responses to speech, noise, or even music. Under certain conditions, however, you may not want this; for example, in a Touchtone decoder where there are two simultaneous tones.

There are several ways to get around this. The best is to first separate the high Touchtone tones from the low, and thus keep the low group tones from the high group decoders and vice versa. This is the way the telephone company does it, and it works well, since it will detect only one tone in the high group and one in the low at a time.

TABLE II
Bandwidth and Level

	Bandwidth adjusted to		
	100 Hz	200 Hz	400 Hz
Minimum Input Required (rms volts)	1.2	0.8	0.6
Measured bandwidth at			
1V rms input	–	150	390
2V rms input	112	210	430
5V rms input	130	230	430
10V rms input	100	210	420

Another, and far simpler way, is to change the decoder to prevent the desensing by signals outside the passband. This is easily done by connecting the anode of CR2 to the



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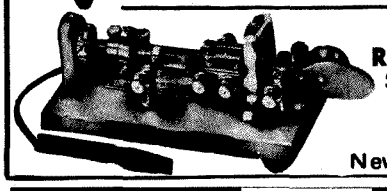
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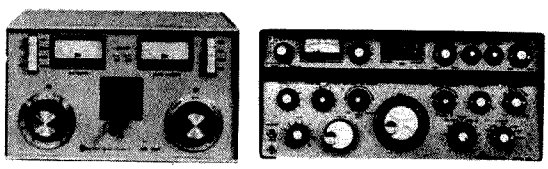
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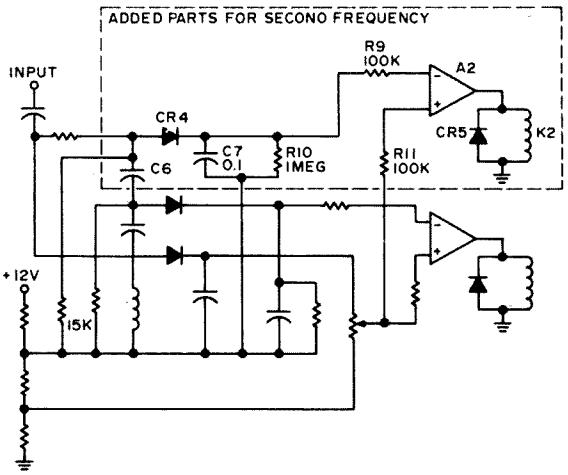


Fig. 4. Two-tone decoder using one toroid.

junction of C1 and R4, instead of to the toroid. This leads to a rather roundabout way of detecting the tone; *any* input signal will try to operate the relay, via CR2 and the plus input of the op-amp. But at the same time, every signal *outside* the passband will try to prevent operation, via CR1 and the minus input. By carefully adjusting R7, we arrange things so only signals *within* the passband succeed.

Along the same lines, Fig. 4 shows how to use *one* toroid to detect *two* tones. If you're careful you might even get more tones out of it, though I haven't tried it. All unlabeled parts in Fig. 4 are the same as in Fig. 3; only parts in the dashed box are added for the second tone.

The values of L1 and C2, in Fig. 3, are chosen to detect the *lower* of the two frequencies, and act as a notch filter at this frequency. Once this is done, C6 is chosen so that the series combination of C2 and C6 resonates with L1 at the upper frequency, to form another notch filter.

In theory, we could add as many of these additional sections as we wanted, and it would be really dandy to have a complete Touchtone decoder with just one toroid, but in practice it won't work. Every added section degrades the Q (and therefore bandwidth) of the whole system. Moreover, the frequency-determining capacitors are shared among several frequencies, and so adjustment becomes really difficult. But it's a cute scheme.

. . .K2OAW

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A Simple Solid-State Flying Spot Scanner For Slow-Scan Television

A flying spot scanner is a device which uses a raster on the face of a cathode ray tube to produce high quality television pictures from either photographic slides or prints and drawings. It is usually more economical to build and easier to adjust than a vidicon camera, a factor which makes the flying spot scanner (FSS) an ideal first camera construction project for the newcomer to SSTV. The ease of operation and picture fidelity of a well designed FSS unit also makes it a valuable station accessory even when a vidicon camera is available. Using the FSS to televise most routine picture material reduces the total operating time on the SSTV camera vidicon, an important factor considering the difficulty in obtaining the special 7290 slow-scan vidicons.

The flying spot scanner which I developed to take the load from my own transistorized camera consists of three separate units:

1. The normal station SSTV monitor, which, in addition to displaying the picture output, provides both operating and deflection voltages for the FSS scanning module.

2. An SSTV test generator which supplies a signal to trigger the sweep in both the monitor and scanning module, a sub-carrier oscillator which is modulated by the scanning module output to produce the picture, and a variety of useful test outputs which are completely independent of the scanning module.

3. The scanning module which consists of a scanning CRT whose deflection plates are slaved to those of the monitor CRT, a 931 photomultiplier, and an FET dc amplifier for boosting the photomultiplier output to a suitable level for driving the test generator sub-carrier oscillator.

How it Works

Figure 1 shows a block diagram of the entire system. With no signal from the scanning module, the test generator produces a composite slow-scan signal consisting of one 30 ms vertical sync pulse of 1200 Hz repeated every eight seconds, 5 ms horizontal sync pulses of 1200 Hz at a 15 Hz rate, and a video tone (between sync pulses) of 1500 Hz. The sync pulses cause a square 120 line slow-scan raster to be produced on the monitor screen which is black due to the 1500 Hz video tone. Since the scanning module CRT has its plates slaved to the CRT in the monitor, a raster is produced on this tube as well. Since the scanning CRT is unaffected by

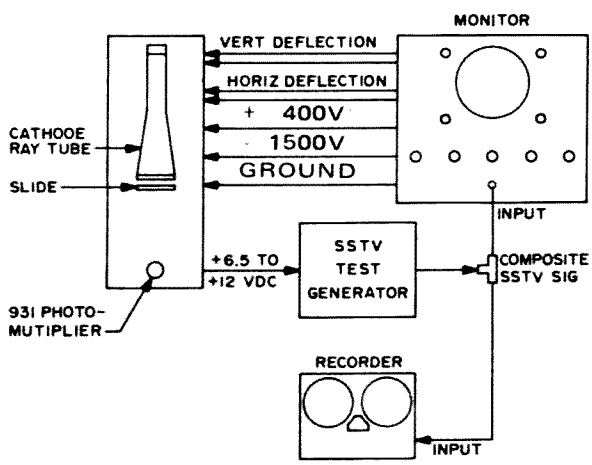


Fig. 1. Block diagram of the solid-state flying spot scanner system.

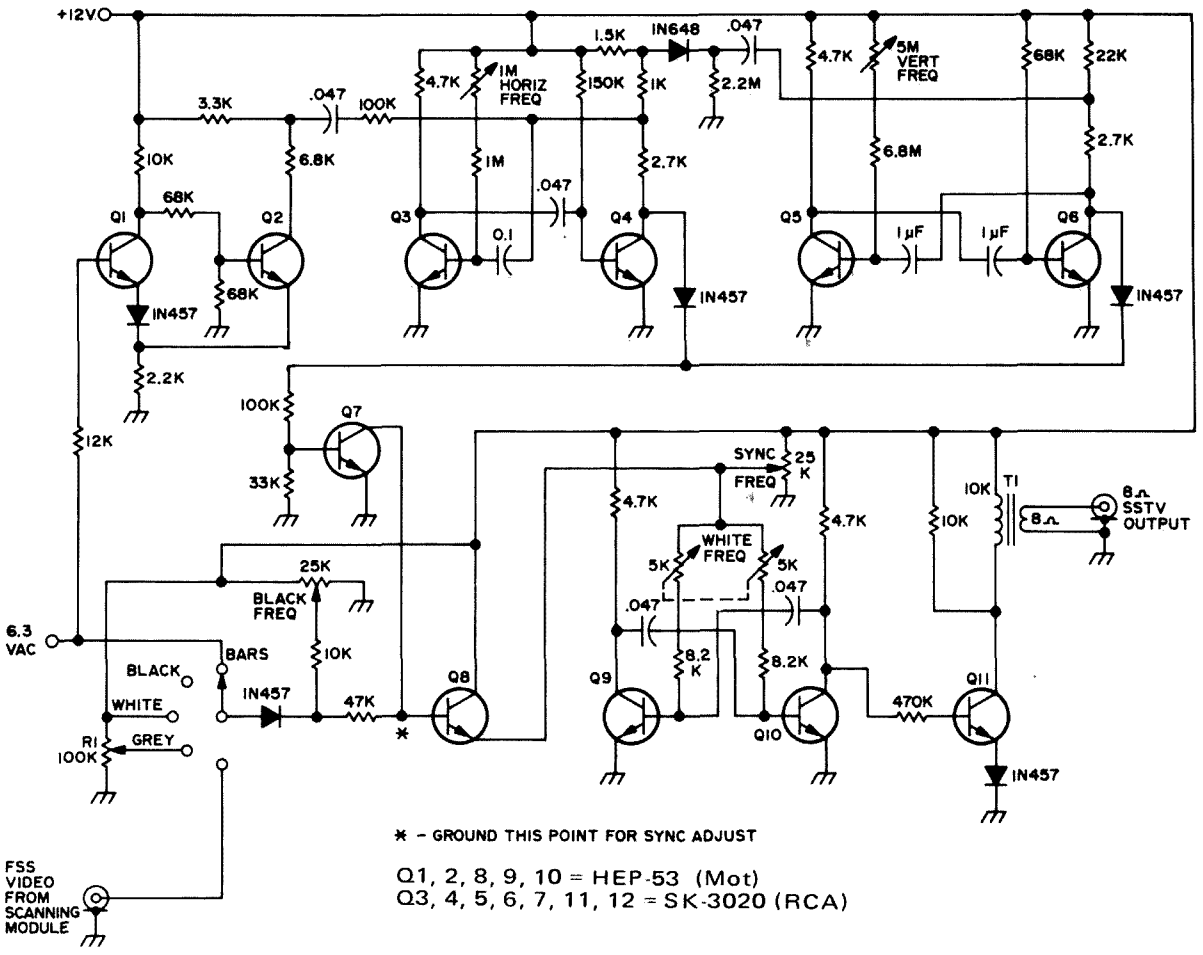


Fig. 2. The SSTV test generator circuit from a circuit described by K7YZZ[1].

the video tone, it can be independently set for a moderately bright raster. A photographic slide is placed over the face of the scanning CRT so that the light from the raster, actually a fast-moving spot of light, must pass through the slide before reaching the 931 photomultiplier tube. The 931 converts the varying light intensity to a minute voltage which is internally amplified by the photomultiplier to a level ranging from −.3V under no illumination (black portions of the picture) to −3.0V under full illumination (white portions of the picture). A single FET is used as a dc amplifier with an adjustable output threshold, producing an output signal ranging from approximately 6.5V (black) to 12.0V (white). This total range, when applied to the test generator, shifts the sub-carrier oscillator from black (1500 Hz) to white (2300 Hz) in a linear fashion, resulting in a replica of the original slide being reproduced on the monitor screen. This video information in no way affects the sync pulses, and since there is no video interconnection between the scanning CRT and the monitor, the picture will remain until the slide is removed from the scanning module CRT face. The brightness control on the scanning module CRT functions as the system contrast control and can be varied to produce the proper light level for good contrast. A T or Y connector is used at the SSTV output jack of the test generator to record the picture output for later playback. The use of the monitor to supply scanning and operating voltages for the scanning CRT and 931 photomultiplier not only reduces cost, but simplifies construction as well.

Construction

Monitor. Very little needs to be done with the monitor to fit it into the system. An auxilliary socket should be installed on the rear apron to make deflection and operating voltages avail-

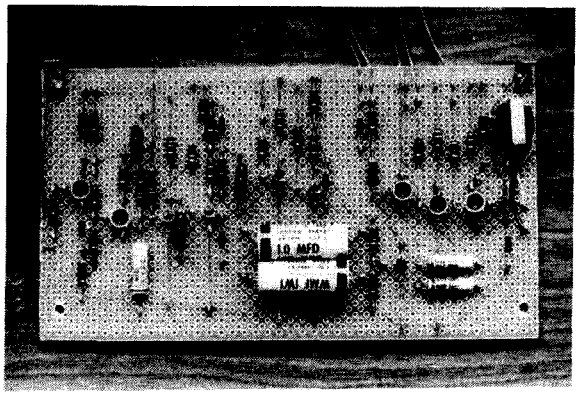


Fig. 3. Photograph of the vector circuit board layout used by the author for the SSTV test generator used in the FSS system.

able. Since the scanning unit should use a CRT that is identical with the one used in the monitor, all required voltages should be available. In my case, I used a six pin Cinch Jones socket for the vertical and horizontal deflection lines (2+2), the 400V required for the astigmatism string, and a ground line. Required high voltages, approximately −1500V and perhaps +1500V (depending on the type of CRT used) are best brought out via standard UHF coax connectors. Care should be taken that the monitor CRT display is completely linear, for the linearity of the finished picture will be governed by this factor since the two CRTs in the system are "slaved" during operation. Vertical non-linearity is the most common type and is usually caused by a faulty discharge capacitor. If necessary, a number of high-quality mylar units should be paralleled to achieve the desired capacity and discharge characteristics.

Test Generator. The heart of the entire system is a solid-state SSTV test generator developed from a circuit described by K7YZZ[1]. The changes incorporated in the circuit have been relatively minor. The transistors originally specified have been replaced by Motorola HEP and RCA SK series general replacement types. These types are usually obtained fairly easily. Some of the RC values have been changed and the "dot-bar" and "sync" test positions have been deleted, while the

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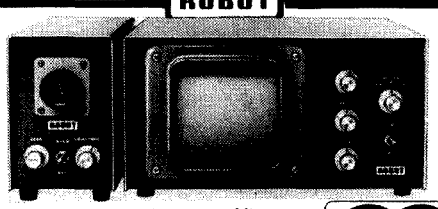
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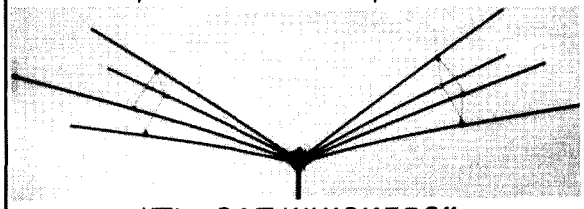
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FSS video position has been added. The unit was constructed in its own cabinet with an internal power supply so that it can be used independently as an SSTV signal source, if required. Figure 2 shows the schematic, while Figs. 3 and 4 show the circuit board and completed unit. The unit is certainly much larger than required and if miniaturization is your thing, it could certainly be reduced considerably in size. In addition to its function in the FSS system, the generator will also produce a black raster, white raster, a raster with a continuously variable grey level, and a stable bar pattern.

Scanning Module. This module consists of the CRT and its associated control circuits, the 931 photomultiplier, and the FET dc amplifier. A piece of cobalt glass, available in most high school chemistry labs, is positioned between the CRT and 931 to filter out the long-persistence yellow component of the P7 phosphor. Without this precaution, the amplified phototube output would continuously drive the sub-carrier oscillator to white (2300 Hz) due to the persistent yellow glow on the face of the CRT. My module is built on a 6x17x2 in. chassis. A shorter chassis could be used if mirrors were used



Fig. 4. Interior view of the completed SSTV test generator. Front panel controls (not shown) include power, function selector (S1), horizontal frequency, and the grey scale adjust (R1). The remaining pots are mounted on the chassis between the circuit board and the front panel. The rear portion of the chassis contains power supply components. The small circuit board includes bridge rectifier diodes and a zener and regulating transistor.

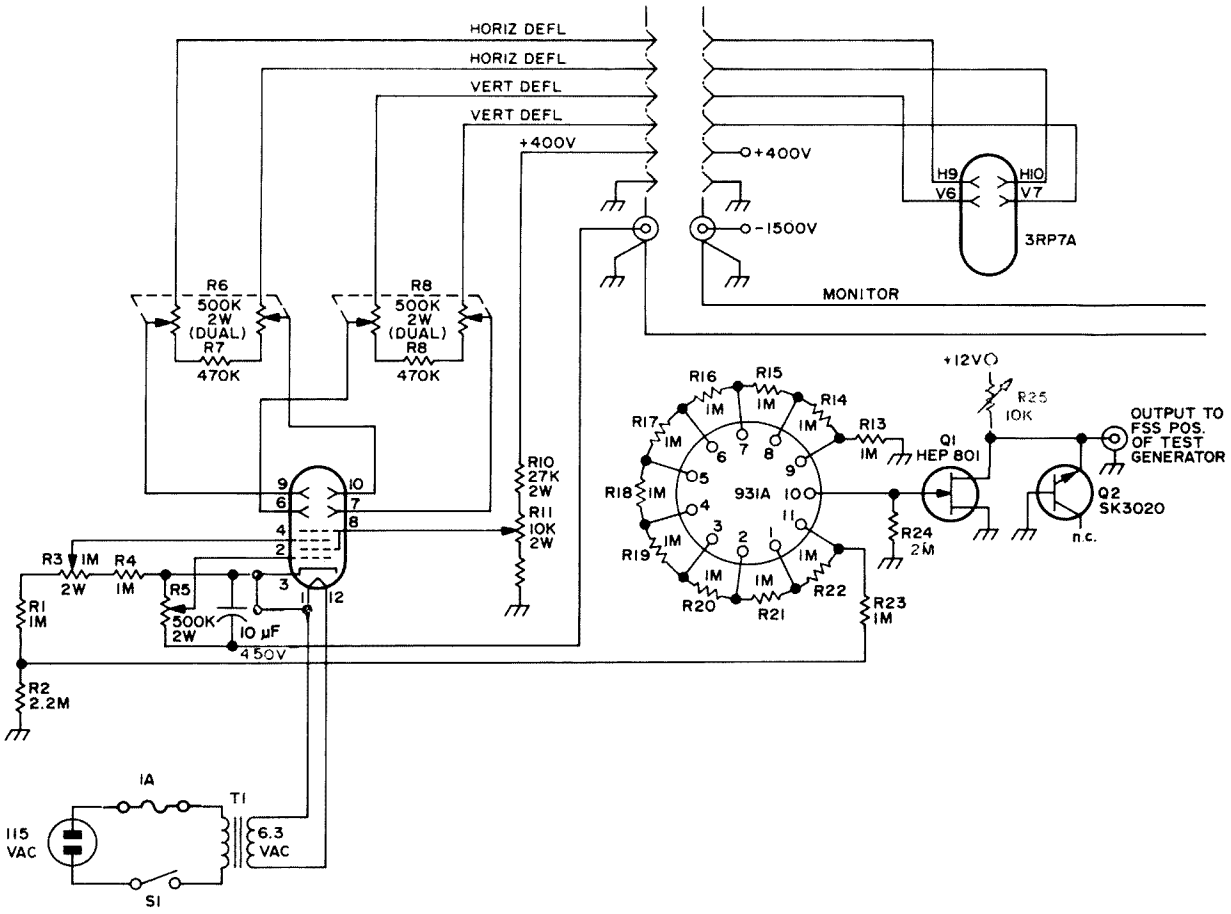


Fig. 5. Scanning module and interconnections with the monitor. The 3RP7A CRT is shown as an example only, for in actual practice the scanning CRT should be of the same type as that used in the monitor. Other CRTs will require different values in the astigmatism and brightness-focus networks and the monitor values should be duplicated. The −1500V is most easily carried via coaxial cable and suitable connectors. If a high positive accelerator voltage is required for the CRT used, it may be carried via a similar cable. Controls are: R6 – Horizontal Size; R8 – Vertical Size; R11–Astigmatism; R5 – Brightness; R3 – Focus; and R25–Dc Level Adjust. T1 is a 6.3V 1.2A filament transformer with secondary windings rated at 2 kV or better.

in the system, but the distance between the CRT face and the photomultiplier should be kept at least 4 or 5 in. if the picture definition is not to be degraded by parallax factors. The CRT should be firmly mounted and some means incorporated to keep the photographic slides pressed firmly against the tube face. Small metal clips may be used or a slide holder can be constructed and attached to the tube face. If elegance or convenience are no object, the slides can simply be taped to the CRT screen! If you plan to use the scanner in a lighted room, a black hood or box assembly can be constructed so that the CRT and the 931 form a light-tight system once the slide is in place. The top of the chassis and the inside of the hood should be painted flat black or faced with black construction paper to eliminate stray reflections.

The schematic of the scanning module and monitor interconnections, Fig. 5, show values in the brightness, focus, and astigmatism networks that are consistent with the 3RP7A used in my own monitor. If your monitor uses another tube, simply substitute equivalent networks from your own monitor circuit. In the event of such a change, be sure to modify the CRT socket connections as required. The 931 requires a negative voltage of some 600 or 700V for proper operation. Alter the relative values of the resistors following the focus pot in your own circuit so that this voltage is available.

High voltage wire should be used where appropriate and the brightness and

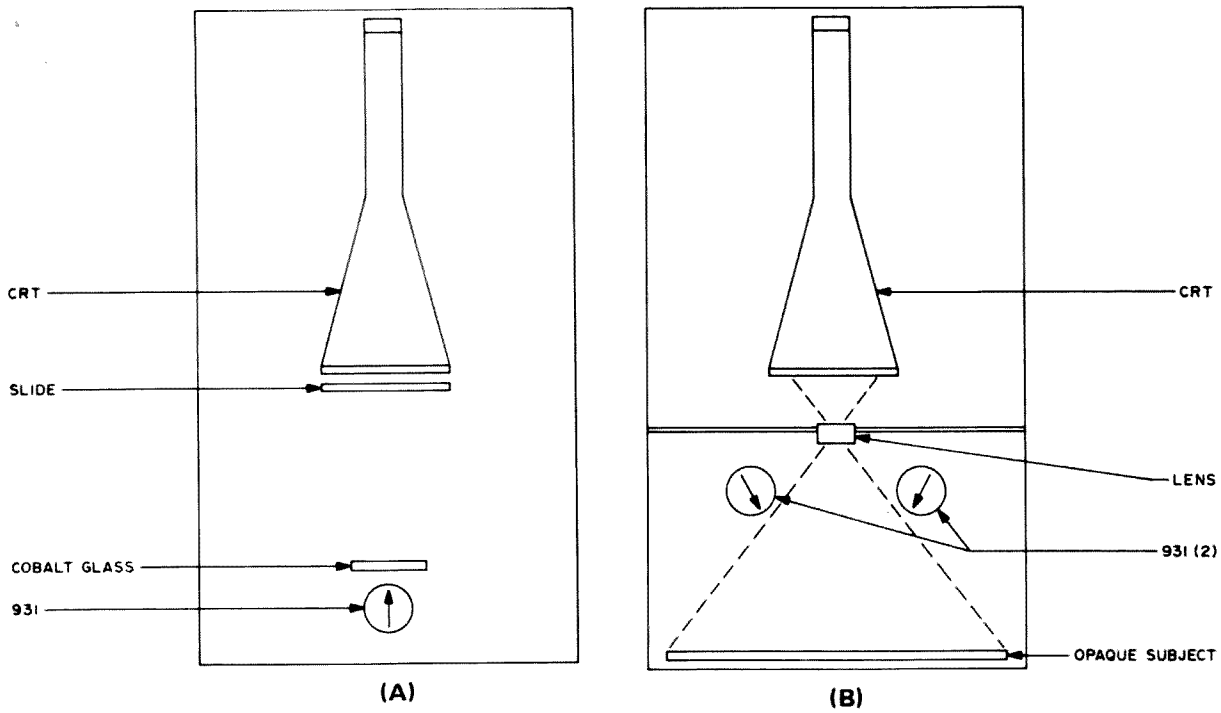


Fig. 6. Diagrams of the mechanical layout for two basic approaches to FSS design. (A) shows the transmitted light system, suitable for photographic slides and other transparencies, used by the author. (B) shows a more complex arrangement, suitable for televising photograph prints and drawings, as used by K7YZZ[2]. The arrows indicate the orientation of the key in the 931 sockets so that the light sensitive area of the tube faces in the proper direction.

focus pots should be *insulated from ground and equipped with insulated shaft extensions.* The focus, astigmatism, and dc output level can be placed anywhere that is convenient as they are rarely adjusted after initial setup. The brightness control is the system contrast control and should be placed for convenient adjustment when the scanner is in operation.

There are actually two options available in constructing the scanning unit. My own unit is built to handle photographic slides and transparencies and the general layout is diagrammed in Fig. 6a. It is also possible to set the scanner up to transmit pictures from photographic prints and drawings. The somewhat more complicated mechanical layout is diagrammed in Fig. 6b. Here a lens is used to focus an image of the scanning raster onto the photographic subject. The light *reflected* from the subject is picked up by two 931 photomultipliers. This approach was used by K7YZZ in his tube FSS circuit[2] and anyone contemplating this approach is urged to consult this article for details of mechanical layout.

Adjustment and Use

The test generator should be aligned first. The generator output should be connected to a frequency counter or some other setup for determining the frequency of the audio output. The base of Q8 should be grounded with a test lead and the sync frequency control adjusted for 1200 Hz output. Remove the

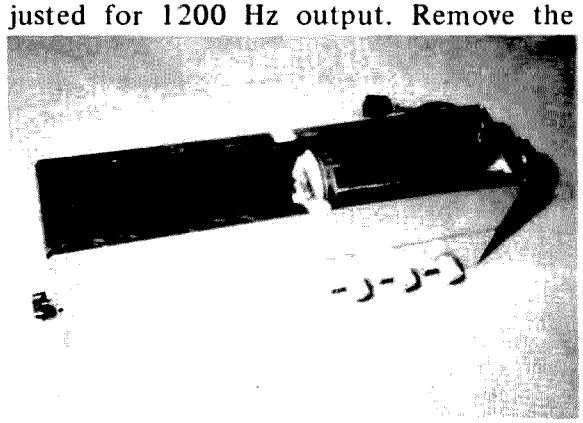


Fig. 7. A photograph of the author's scanning module. The CRT is enclosed in an alloy shield to eliminate the effect of external magnetic fields. The 931 on the far left has been painted black except for the photosensitive "window" while the chassis enclosure has been lined with dark felt. A felt lined cover is placed over the top of the unit after the slide is in place.

test lead and switch S1 to the "black" position, adjusting the black frequency control for 1500 Hz output. Switch S1 to the "white" position and adjust the white frequency control for 2300 Hz output. This series of adjustments should be repeated several times as there is some interaction between the various frequency controls. The generator should then be connected to the monitor and S1 switched to the bars position. The horizontal frequency should be adjusted for a stable display of four vertical white bars and the vertical frequency should be adjusted for an eight sec. frame time. At this point, without plugging the scanning module into the test generator, the following monitor displays should occur at each setting of S1:

BARS – four vertical white bars on a black background.

BLACK – a pure black raster.

WHITE – a pure white raster.

GREY – a raster whose intensity can be varied from black to white using R1.

FSS VIDEO – a black raster.

Turn out all of the room lights or cover the 931 photomultiplier. Plug the video line from the scanning module into the generator and apply power to the scanning unit. The dc level control should be adjusted to the point where the subcarrier output *just* begins to rise above 1500 Hz. Turning on the room lights or removing the cover on the 931 should immediately cause the raster on the monitor to go from black to white. Turn out the room lights and adjust the scanning module brightness, focus, and astigmatism controls for a moderately bright, well-focused raster. The respective size controls should be adjusted for a square raster of a size appropriate for the slides being used. Very small adjustments in centering can be made using the monitor centering controls. Put a slide in place and adjust the scanning module brightness control for the best picture contrast when viewed on the station monitor.

Photographic slides, either color or black and white, may be used directly in the system. Call signs and other printed material can be prepared on clear acetate using dry transfer lettering. "Instant" slides can be made on acetate using india ink, wax marking pencils, or many of the felt tip pens available on the market. Various portions of the slide may be cropped or enlarged, within the resolution limits of the CRT, by changing the size and position of the scanning raster. Figure 8 shows some typical output from the system. Building a system of this sort is certainly one of the easiest and least expensive ways to produce high quality SSTV pictures.

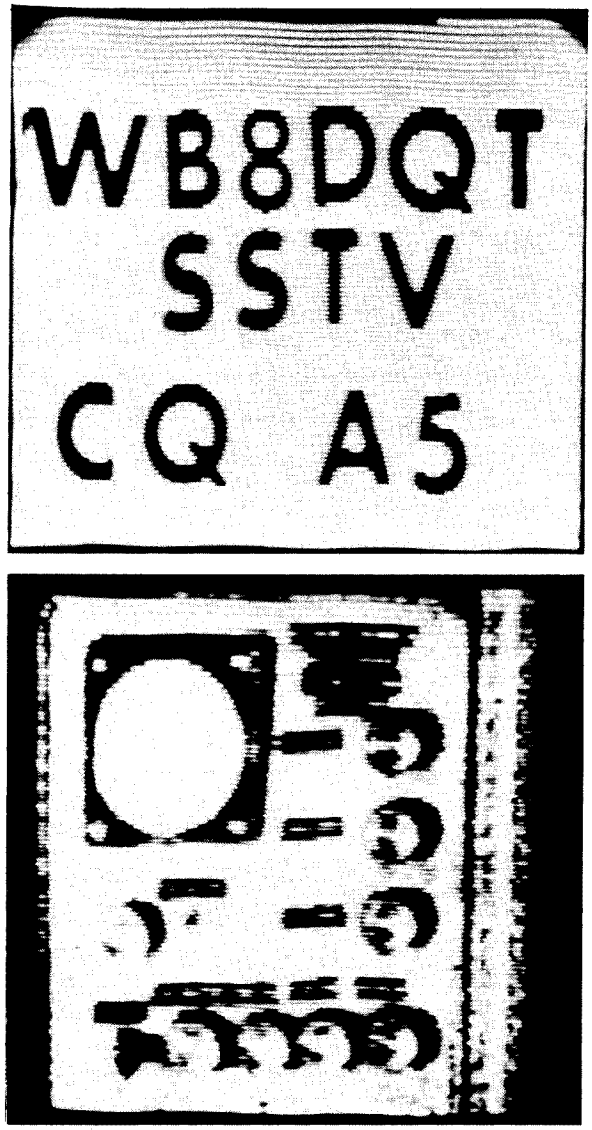


Fig. 8. Typical picture output as viewed on the author's SSTV monitor.

. . .WB8DQT

References cited:
[1]Hutton, L. K7YZZ. A Slow-Scan Television Signal Generator. 73 Magazine, July 1969.
[2]Hutton, L. K7YZZ. A Slow-Scan Television Picture Generator. 73 Magazine, October 1967.

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State College PA 16801

ACTIVE FILTER DESIGN AND USE PART II

Although information concerning active network theory in the form of inductorless filters was published by Linvill in 1954, it is only since the popularity of solid-state devices and miniaturization that renewed research has shown their real potential.

In seeking a starting point for active filter design, we must consider the desired function of the network and its passive LC or RC counterpart. A basic LC low-pass filter can be used as a design prototype for any of the other filter types. Similarly, basic RC networks will be used as design prototypes for active filters. In choosing a network which we hope will produce the desired response, it is important to remember that some designs are more applicable to specific functions than others. For instance, RC ladder networks lend themselves to low and high-pass designs. The RC twin-tee notch configuration functions well as a bandstop or adjacent frequency elimination network, while RC active peaking networks provide the Q for a bandpass response. Where it is necessary to improve the performance of the single network, active sections may be cascaded, much like multiple section LC filters.

Figure 1 shows a third-order active low-pass filter with the three poles being simulated by frequency-dependent capacitors C1, C2, and C3. The resistances R1, R2, and R3 serve to vary the frequency response by altering the gain, impedance, and waveshape. The cutoff frequency f_o for this filter is given by:

$$f_o = \frac{1}{2\pi R C}$$

The RC product in the above formula incorporates the sum of the individual values of resistances and capacitances in the network. The circuit of Fig. 1 is a unity gain amplifier when operated under optimum conditions. In addition, the gain will be primarily dependent upon the value of R, which is always in series with the signal flow. Moreover, the value of R is, to a great

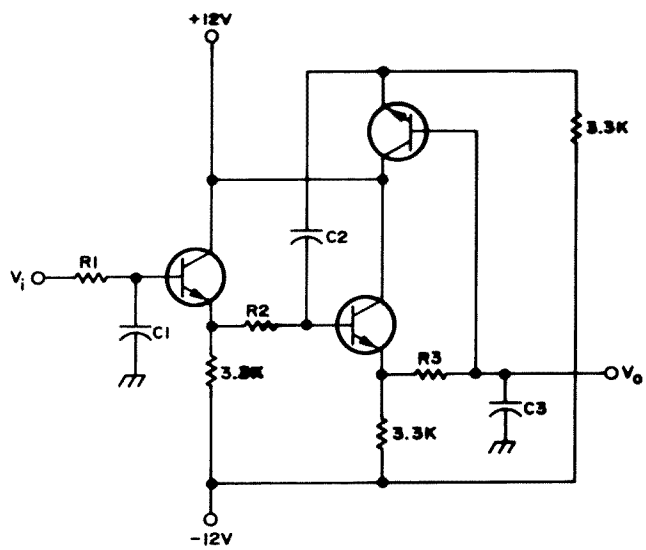


Fig. 1. Active low-pass filter.

Table I

	$C_{1,2,3}$	$R_{1,2,3,}$	Insertion Loss	f_o	-3 dB	-10 dB	-20 dB
A	.001	620	8 dB	28 kHz	100 kHz	175 kHz	220 kHz
B	.001	1 k	7 dB	17 kHz	75 kHz	140 kHz	300 kHz
C	560 pF	4.7 k	17 dB	7 kHz	50 kHz	90 kHz	160 kHz

extent, dependent on the corresponding value of C. In practical consideration, the cutoff frequency is limited by the required value of €. As the value of C is decreased, and R remains the same, the cutoff frequency is increased. The same is true for the resistor values. Consequently, there is a point where minimum capacitance requires the increase in the value of R to obtain a higher cutoff frequency. This is done at the expense of higher insertion loss or lower gain.

The value of the emitter resistors was chosen as optimum for maximum gain of the MPS 6520 transistors. Table I gives the results of trying different values of R and C in the low-pass filter circuit. Figure 2 shows the plotted frequency response for the values of Table I. From these results, it is obvious that two major areas require improvement. Of greatest importance is the lack of a sharp cutoff at the −3 dB point. We should also expect a minimum of 15 dB attenuation per octave. High insertion loss also affects the overall response, flattening the peaks and decreasing the gain. A reasonable improvement should be expected if we could design a similar filter with less insertion loss and steeper slope.

Figure 3A shows two cascaded RC networks. When this two-pole network is placed in the signal path, each section (R1C1 or R2C2) exhibits its individual frequency characteristics, which are algebraically added to produce the final filter shape response. In other words, if the network consisting of R1C1 had a rolloff around 1 kHz, and R2C2 extended this cutoff to 2 kHz, we could not expect to obtain a summed cutoff frequency of 3 kHz by cascading the two networks, but the resulting −3 dB point would be closer to 1.5 kHz. Although we may sharpen the response curve at the −3 dB point by cascading the two networks, we will have the problem of high insertion loss and minimum attenuation slope. By separating the two networks, consisting of R1C1 and

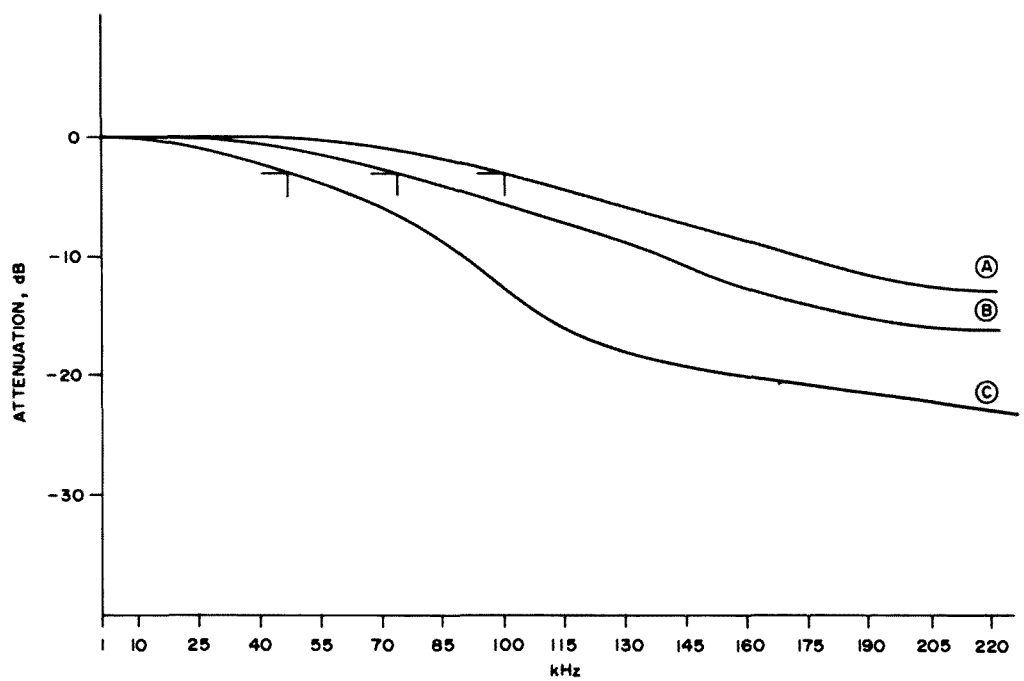


Fig. 2.

R2C2, and utilizing them as input and output circuits of an amplifier, we can lower the network insertion loss and alter the final filter response.

In Fig. 3B, the signal is fed to an amplifier (A) from which a feedback line (beta) is taken to be reinserted at the RC network. Figure 4 shows the results of variations of network component ratios and circuit design for a low-pass filter. The damping factor d is a measure of the two-pole response at the −3 dB point. Its value is dependent upon the network Q. The steeper the response curve, the greater the Q and the smaller d must be:

$$Q = \frac{1}{d}$$

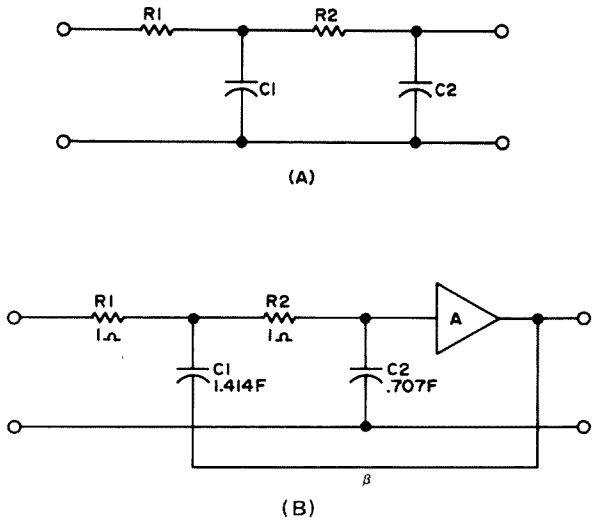


Fig. 3. Normalized lowpass filter.

Without feedback, Fig. 4 shows that the best response we can expect is where parameter d is equal to one. Such a curve would be the result of a passive RC network with a maximum gain of unity, as shown in Fig. 3A, or the active network of Fig. 1. By utilizing a feedback loop, the slope can be modified to the curves showing d equal to less than one. If an amplifier is incorporated before the feedback loop, d becomes a function of gain and feedback. In this case, the frequency characteristics take on the shape of the curve where d is equal to much less than one.

Figure 5 shows an active network which can be designed to provide any value of d for a given corner frequency ω_o. Transistor Q1 is an emitter follower stage biased for maximum gain (unity) and stable operation. The signal is direct-coupled to the emitter of Q2, and from the collector of the amplifier to the output through the emitter follower Q3. This arrangement allows transistor impedances to be matched and provides a gain (k) greater than unity, although naturally less than with a common emitter amplifier. Due to the required configuration of the filter section, the signal source appears as a constant-current generator. Therefore, the signal baselines, normally considered as zero, may be above the dc zero reference value. This possibility

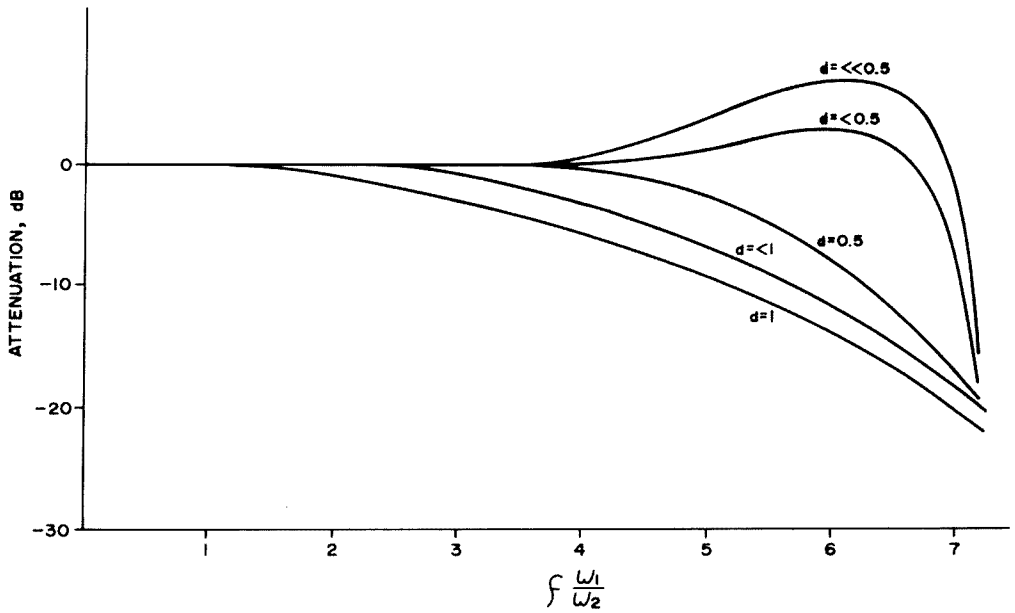


Fig. 4.

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makes biasing of Q1 different from normal capacitor-coupled configurations. The base must remain positive, with respect to the emitter, for the entire swing of the input signal, regardless of where the signal baseline may be. Failure to provide correct biasing will cause clipping of the negative portion of the waveform, or when bias is too low to allow the transistor to conduct, the scope display will appear as though there is a loose connection or a ground lead missing.

The input impedance of the active filter is high while the output impedance is low (approximately 600Ω), thus lending itself to incorporation into transistor circuitry. Power supply leads should be decoupled to prevent signal loops which might cause shape distortion or oscillation.

The shape of the frequency characteristic is mainly dependent on the ratio of R1C1 to R2C2 and the amount of feedback voltage determined by the ratio of R10 to R11. The gain k of the amplifier is set by the ratio of the resistors R8 and R9. To achieve good slope attenuation, the response of the active section of the filter must be combined with that of the passive section R1C1. This requires a βk factor of greater magnitude than would be necessary for the active filter without the passive section.

In designing the RC sections, R1 and R2 should be relatively low in value for good temperature stability. The ratio of C1 to C2 can be considered to be 10 for a good starting point. By the use of impedance and frequency scaling, we can obtain values for R1C1 and R2C2. These values will not be final filter values since changing R or C may be necessary to obtain the desired response shape in conjunction with feedback and gain. Therefore, a change in R requires a change in the value of the corresponding C. In Fig. 3B, values have been assigned to the components to produce a normalized active filter network for 1 radian per second. These prototype values are for two-pole Butterworth filters. To determine the value of C, we utilize the frequency scaling formula:

$$C' = \frac{C}{2\pi f_c}$$

In this equation, C′ indicates value after frequency scaling.

For a Butterworth response with a cutoff frequency of 2.5 kHz (−3 dB point), we obtain for C1:

$$C'1 = \frac{1.414}{6.28(2.5\times10^{3})}$$
$$= 0.09\times10^{-3}\,F = 90\,\mu F$$

For C2:

$$C'2 = \frac{.707}{6.28(2.5\times10^{3})}$$
$$= 0.045\times10^{-3}\,F = 45\,\mu F$$

To achieve convenient values of capacitance and impedance, we need only use a constant value applied to the components of each section. The constant need not be the same for each section. Using the chosen constant to divide the capacitance and

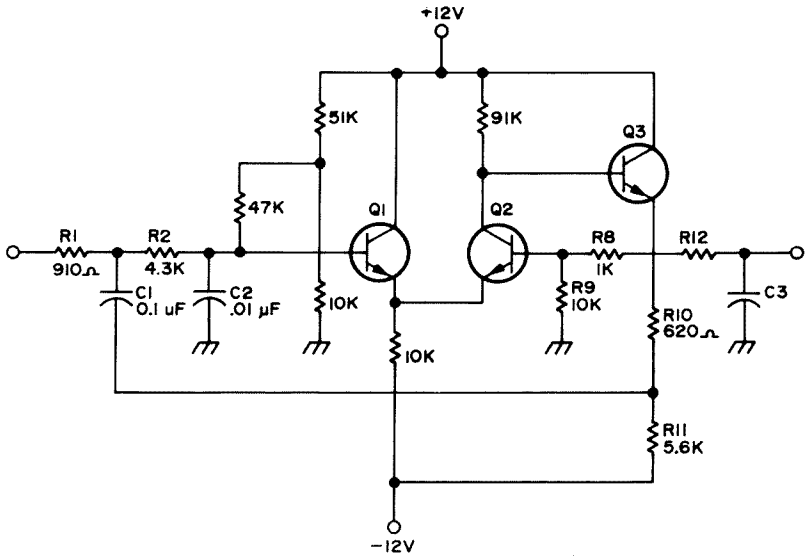


Fig. 5. Active low-pass filter.

multiply the resistance prototype values, a trial RC network is produced. Utilizing 900 as the constant for the R1C1 section, we obtain:

$$C1 = \frac{90}{900} = 0.1\ \mu F$$

$$R1 = 900(1) = 900\Omega$$

If we choose 1000 as the constant for the R2C2 section:

$$C2 = \frac{45}{1000} = 0.045\ \mu F$$

$$R2 = 1000(1) = 1\ k\Omega$$

Figure 6 shows response curves for the above computed RC values with gain varying resistors R8 and R9 having values of 1 kΩ and 10 kΩ respectively. The curves show the effect of decreasing or eliminating R10, thus increasing feedback β. From Fig. 6, the factor βk must be increased and the cutoff frequency/attenuation slope must be decreased while maintaining a passband within ±1 dB. Figure 5 shows the final design and Fig. 7 the response curve for the active low-pass filter. To obtain the 10:1 ratio of C1:C2, and decrease the cutoff frequency/attenuation slope, the values of C2 and R2 were changed to 0.01 μF and 4.3 kΩ. The passive section consisting of R12 and C3 in Fig. 5 may be utilized at very low frequencies to flatten the passband. Values for these components can be computed by the formula:

$$f_c = \frac{1}{2\pi R C}$$

At higher frequencies (above 1 kHz) the passband should be flat within ±1 dB

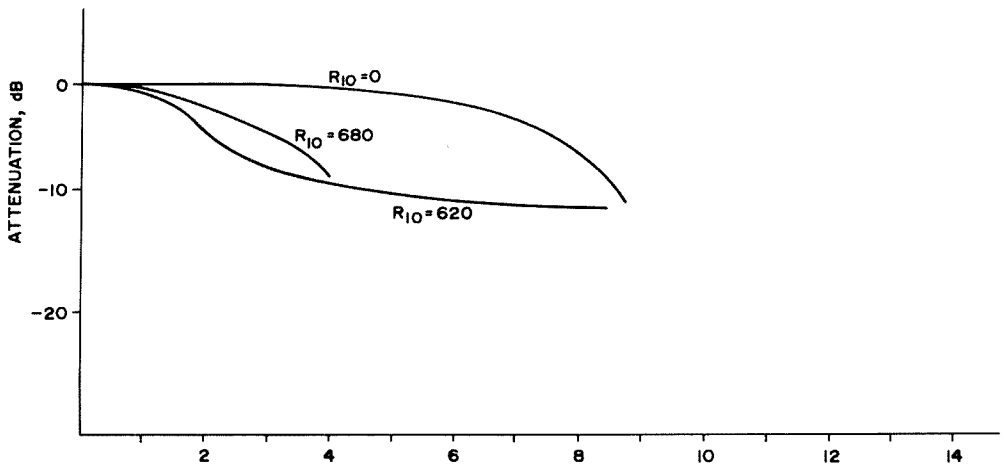


Fig. 6.

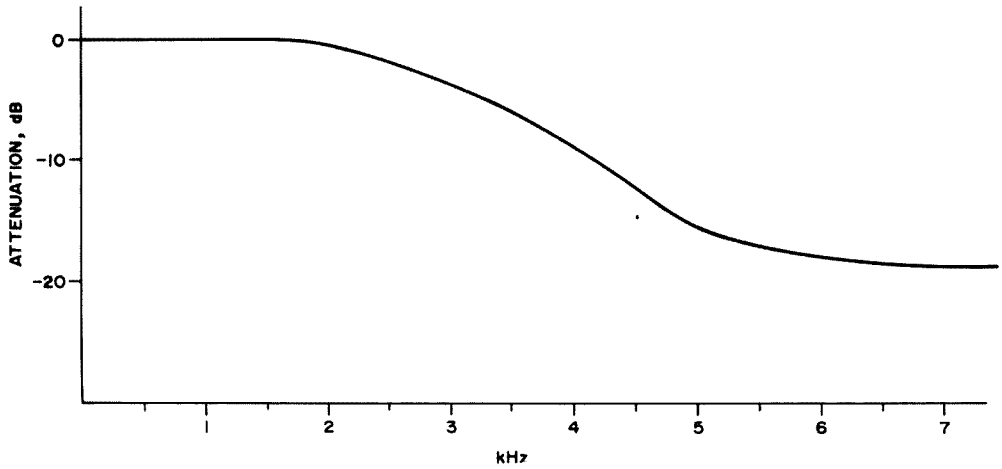


Fig. 7. Low-pass response.

without the added passive section. Consequently, the active network can exhibit gain without these components.

By changing the positions of the LC components, and finding the reciprocal values, a low-pass filter became a high-pass network. Similarly, as shown in Fig. 8, the same principle can be applied to RC active filters. The branches which originally contained capacitors are now made up of resistors with the normalized value of the reciprocal of the constant values of 1.414 and 0.707 originally assigned the capacitors in the low-pass network. In the new high-pass filter the original resistors are replaced by capacitors, also normalized for a cutoff frequency of 1 radian per second.

Frequency scaling to determine the values of CI and C2 at a 3 dB cutoff frequency gives:

$$C'1,2 = \frac{C}{2\pi f_c}$$

$$= \frac{1}{6.28(2.5\text{x}10^3)}$$

$$= 63.7\ \mu F$$

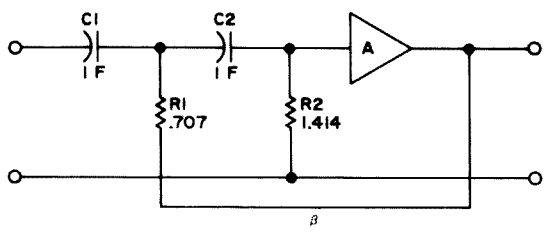


Fig. 8. Normalized high-pass filter.

Impedance scaling is similar to the low-pass procedure where the capacitor values are divided by a constant value and the resistors are multiplied by the same figure. The constant may be different for each section. If we attempt to begin with a 10:1 ratio for the parallel branches, and choose values of 100 for R1 and 10 for R2, impedance scaling provides:

$$R1 = 0.707(141.4) = 100\Omega \qquad R2 = 1.414(7.14) = 10\Omega$$

$$C1 = \frac{63.7}{141.4} = 0.45\ \mu F \qquad C2 = \frac{63.7}{7.14} = 8.92\ \mu F$$

The active high-pass network functions as a voltage amplifier, thus requiring different biasing than the low-pass filter. By utilizing R2 as a bias resistor in addition to

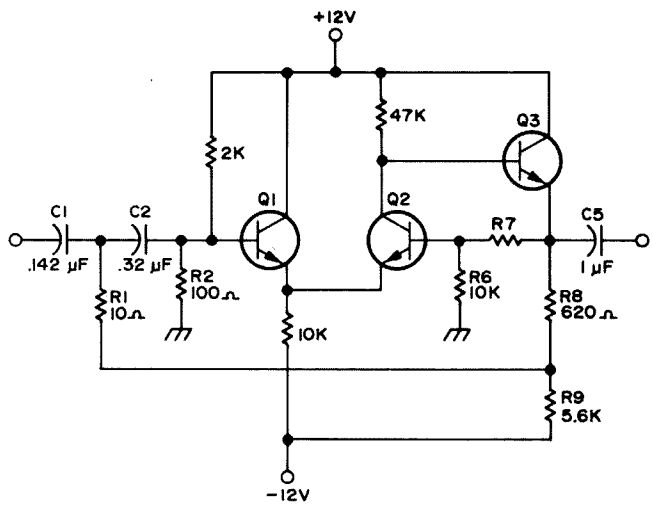


Fig. 9. Active high-pass filter.

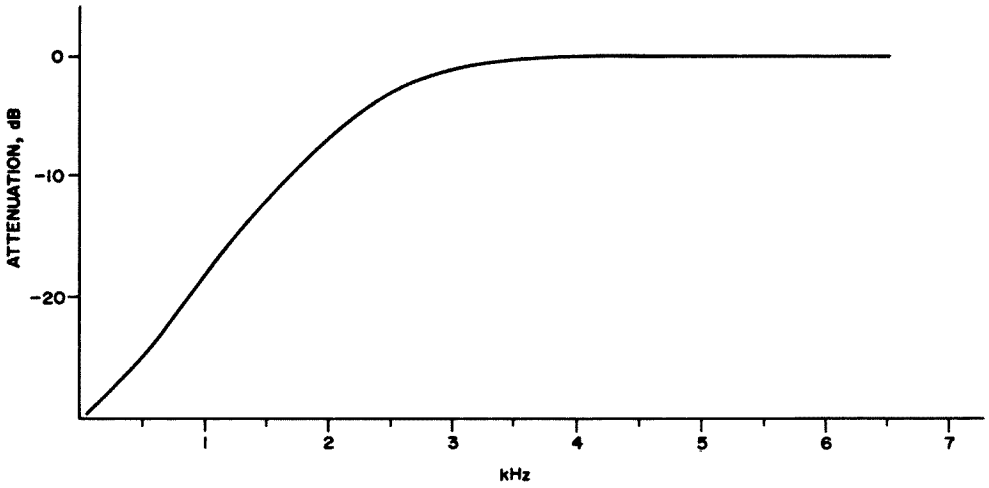


Fig. 10. High-pass response.

its function in the passive section, design is simplified. To increase the bias on Q1, R2 must be greater than 10Ω. Exchanging the positions of R1 and R2 provides the necessary base bias on Q1, maintains a 10:1 ratio in the parallel filter branches, but requires recomputation of C1 and C2:

$$R1 = 0.707(14.1) = 10\Omega \qquad R2 = 1.414(71.4) = 100\Omega$$

$$C1 = \frac{63.7}{14.1} = 4.5\ \mu F \qquad C2 = \frac{63.7}{71.4} = 0.89\ \mu F$$

As in the active low-pass filter, the ratio of R2C2 in conjunction with the feedback components R8 and R9 determine the response shape of the high-pass filter. The final values of these components, obtained by altering the ratios, is shown in Fig. 9. The response shape of the active RC high-pass filter is plotted in Fig. 10.

To obtain bandpass or bandstop responses we need only combine the characteristics of the low-pass and high-pass filters. In Fig. 11A, the combined re-

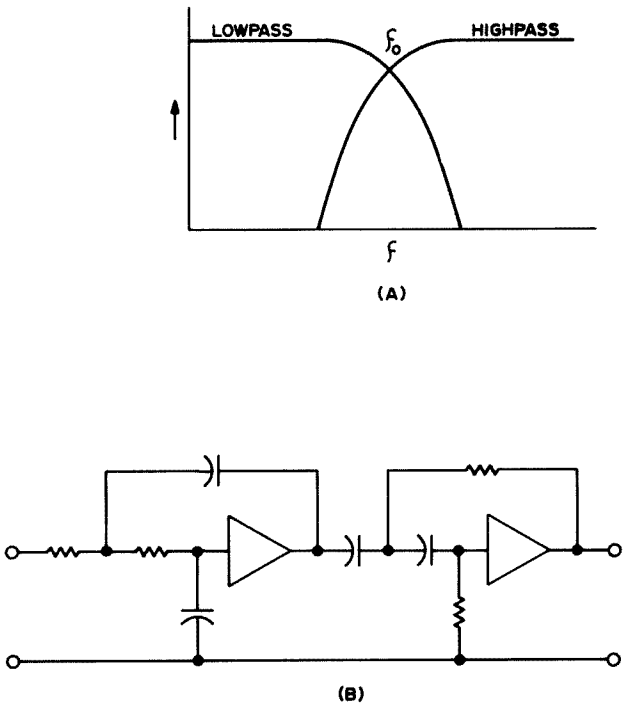


Fig. 11. Active bandpass scheme.

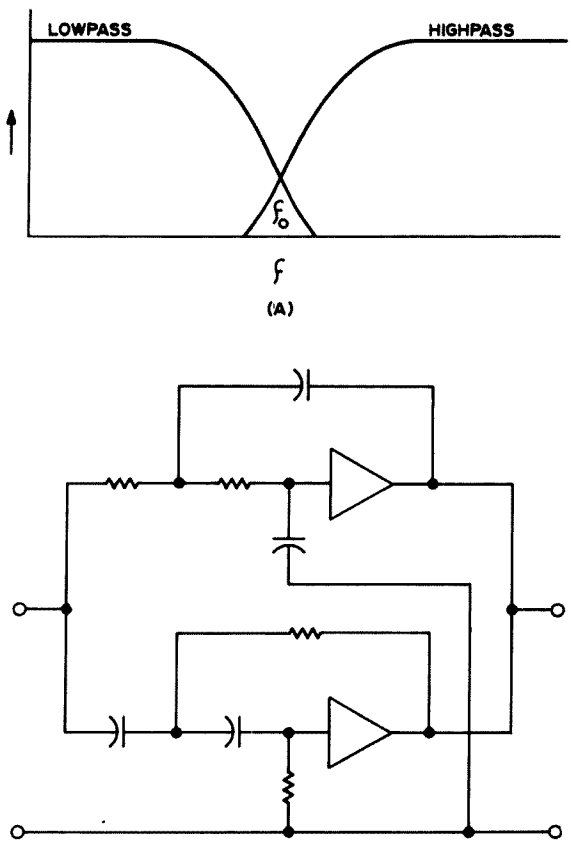


Fig. 12. Active bandstop scheme.

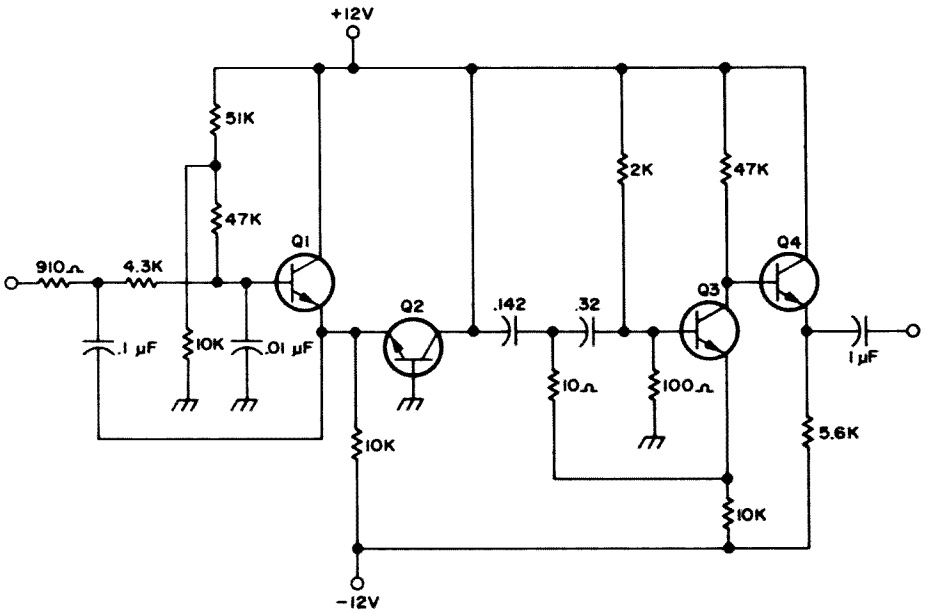


Fig. 13. Active bandpass filter.

sponses of a cascaded low-pass and high-pass filter, as shown in Fig. 11B, are displayed as simple curves superimposed one on the other to form a bandpass shape. To assure the desired response and maintain symmetry, some sort of peaking is required at f_0. This is normally a function of Q. Algebraically summing these two networks will produce a bandstop response as shown in Fig. 12. Normalized values for these prototypes are the same as given in the two previous designs.

In Fig. 13 we have cascaded a low-pass and high-pass filter to obtain a bandpass response. The passive filter component values are the same as used with the individual low-pass and high-pass filters described earlier. Transistor Q2 functions as a buffer between filter sections to preclude distortion of the response due to loading. Although the biasing values are the same as utilized on the earlier active filters, rebiasing will improve the insertion loss caused by dual series filters in a unity-gain network. Figure 14 displays the response of the network for the values given in Fig. 13. The initial response is reasonably flat for two octaves with good slopes to −15 dB.

Passive RC tee configurations have the poles of the transfer function on the negative real axis of the complex frequency plane, and they occur only once at any given point. However, zero locations are dependent upon the circuit configurations and can occur anywhere in the complex

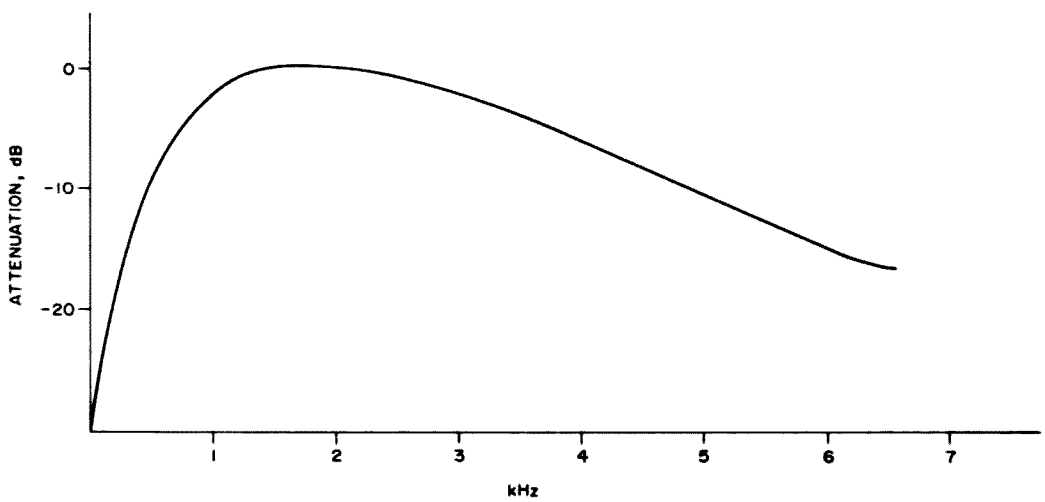


Fig. 14. Active bandpass response.

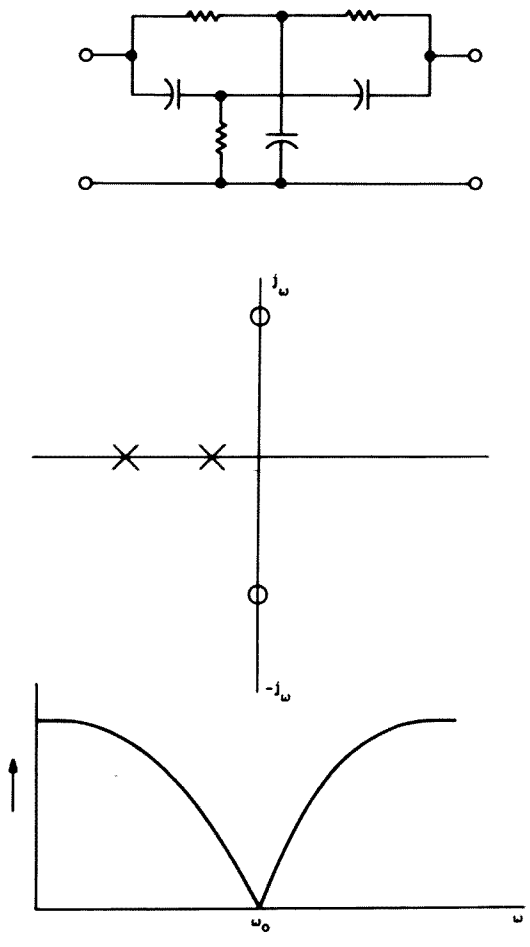


Fig. 15. Twin-tee scheme.

plane. A parallel arrangement of two tee networks and their pole-zero plot and response is shown in Fig. 15. By using the tee network with feedback, the figure of merit, or Q, can be improved by a factor of 80–100 over the value of less than 1 obtained with unity gain.

In Fig. 16, the twin-tee network has been inserted between the emitters of Q1 and Q2. This location precludes the effect of loading input or output which would produce distortion in the response. Rebiasing of the transistors may be necessary to set input signal limits and adjust gain. Operation is similar to the preceding designs in that feedback and gain are varied by R11, R12 and R9, R10, respectively. The values of the components making up the twin-tee network may vary from design to design. To retain a symmetrical response, the network must see a common input and output impedance. The ratios of R4, R5 to R6 and C2, C3 to C4 determine Q, center frequency, and in what area of the transistor curves the amplifier/filter will operate. It is therefore necessary to change the ratios to obtain the desired values of the above listed parameters, in addition to assuring operation of the network as a bandpass, bandstop, or other type of filter.

The following formula may be used to determine center frequency:

$$f_o = \frac{1}{2\pi R C}$$

In designing a bandstop network for 1200 Hz, we might choose a resistance of 1.5 kΩ giving a value of C:

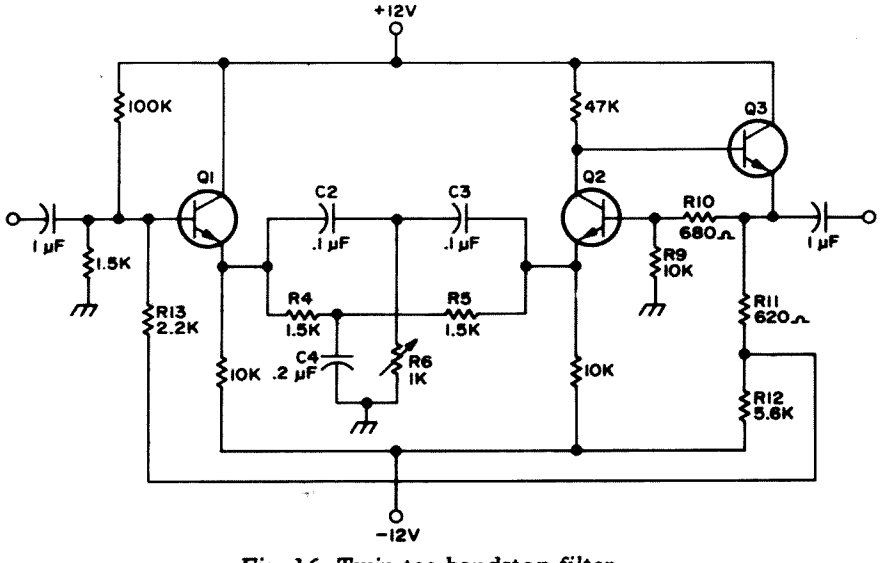


Fig. 16. Twin-tee bandstop filter.

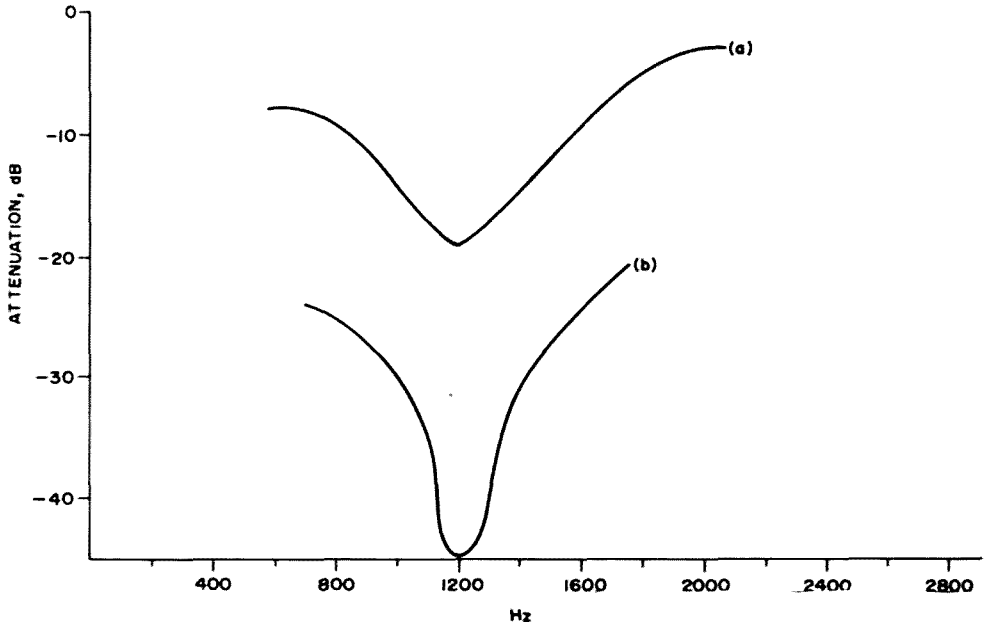


Fig. 17. Active bandstop response.

$$C = \frac{1}{12x10^2(6.28)(1.5x10^3)}$$

$$= 0.088\ \mu F$$

The vertical branches of the twin-tee network normally contain a resistance of half the value of the horizontal component and a capacitance of twice the value of the horizontal component. The tee network of Fig. 16 was breadboarded with C2 and C3 at 0.1 μF for convenience in choosing C4. R6 was made variable to allow final adjustment of the center frequency. The main feedback loop, consisting of R13, was chosen for best performance while monitoring the response on the oscilloscope. A lesser feedback loop also exists from the collector of Q3 to the base of Q1. This feedback is negative in nature and can be used to stabilize the network when required. Figure 17A shows the response for the active bandstop filter.

By changing the ratio of RC in the twin-tee network, a more desirable response can be obtained, as the expense of insertion loss. Figure 17B shows the filter response when the elements of the tee network were changed to the values given in Fig. 18. In addition, the use of less feedback (R13) tended to steepen the low frequency slope. Increased feedback flattened the slope producing the appearance of a high-pass response. Therefore, no feedback was used in the end design. Rebiasing the network would probably decrease the insertion loss.

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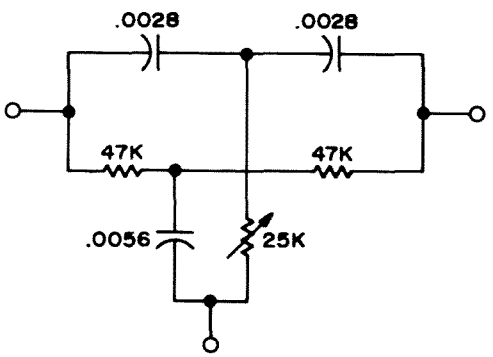


Fig. 18. Narrow bandstop network.

References:

Lowpass Filter for Sub-Audio Frequencies. R. C. Onstead; Transistor Circuits; McGraw Hill

Feedback Improves Parallel-T-Filter. James Strattan; Electronics; September 5, 1966

The Operational Amplifier. Julian M. Pike; QST; September 1970

Twin T's: Designs & Applications. Fred B. Maynard; Electronics World; August 1968

Active Filters: Part 1 The Road to High Q's. Joseph Mittleman; Electronics; May 27, 1968

Active Filters: Part 13 Narrowing the Choice. Michael Hills; Electronics; October 27, 1969

Synthesizing Active Filters. Sanjit K. Mitra; IEEE Spectrum; January 1969

Active Filters: Part 12 Shortcuts to Network Design. Robert R. Shepard; Electronics; August 18, 1969

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AUSTRALIA	14	14	14	7A	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	14	7	7	7	14	14	14	14	14	14A
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INDIA	14	14	7A	7B	7B	7B	14	14	14	14	14	14
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PUERTO RICO	14	14	7A	7	7	7	7A	14	14	14	14	14
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U.S.S.R.	14	14	7A	7	7	7	7	14	14	14	14	14
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A = Next higher frequency may be useful also.
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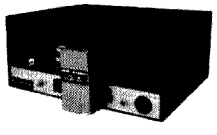
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(continued from page 128)

the Knoxville situation will improve. I mention the HXD situation because I think many repeater owners have the same problem – the 80/20 syndrome.

Many of you had the chance to work the KC4DX DXpedition on Navassa Island a couple of weeks ago. How many of you had a chance to take advantage of another first? Wayne Green, W2NSD/1 took along his slow scan gear on the DXpedition and made several SSTV contacts from Navassa with excellent pictures. Wayne will be taking his SSTV gear along with him on his upcoming trip to Jordan and several other rare spots. In fact, he will be operating SSTV/mobile. Should provide a lot of fun and a lot of new countries on SSTV. Although I have not had a lot of time to use it, I am set up for slow scan with the Robot line. I have made a few contacts and find SSTV a lot of fun.

When I proposed DX repeaters a few months ago, I had no idea the response would be so great. Basically, I proposed we have several repeaters around the country interlinked via 10 meters FM. Such a system would allow users of a local 2 meter repeater to gain access to another 2 meter repeater located in another part of the country. Or, the world, for that matter.

Although it may seem complicated at first glance, the system I propose is so uncomplicated it hurts. All that is needed is a 10 meter base station, a tonal decoder, a COR, and a "Fail safe" timer. Here is how the system would work: assume we have a 34/94 machine in California and a 34/94 machine in Florida with the DX link. Under normal conditions both repeaters are simply 34/94; the DX link is inactive. Let's say a Florida user of his local machine wished to communicate with California. He simply transmits two tones. The first tone turns on his local repeater's DX link so that any 29.680 signals heard by his machine will be sent down to him on 94. After he determines the DX frequency is not in use he transmits a second tone that turns on the California 34/94 machine's DX link. He will then hear any activity on the California 34/94 machine. Plus, of course, his own Florida 34/94. After the DX contact has been completed, a reversal of the tones will shut down the DX link.

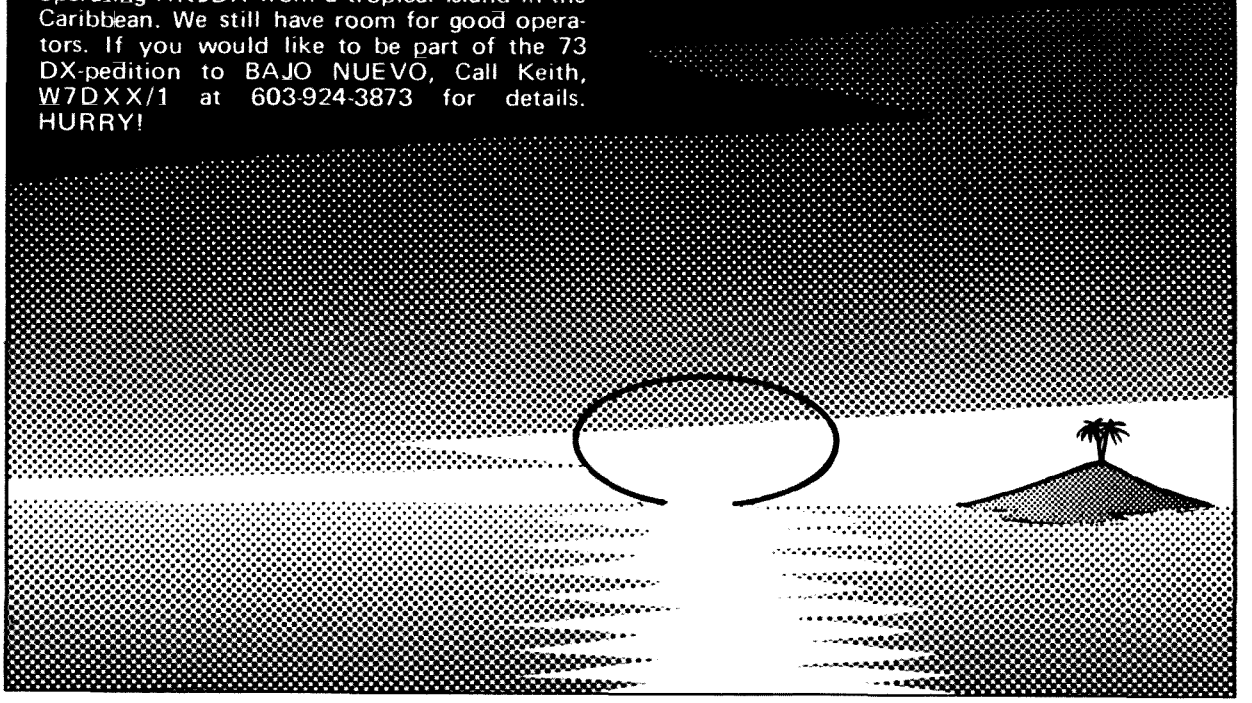
At this point it would be a good idea to mention the "Failsafe" timer. This is simply a drop-out timer to shut down the DX link after 60 seconds of no carrier on 29.680.

I've shown how two 34/94 machines can be interconnected via ten meters. All that is needed is separate control tones for each repeater and several machines can be tied together in this manner. Obviously, there are a couple of variables, namely conditions on 10 meters. Although 10 meters is generally open all over the country during the day, there are times when the band is closed to a particular part of the country (like at night?) and inter-tie with a certain area may be difficult. But remember, many of the variables of working DX are done away with in this system. Primarily, since we are using crystal controlled frequencies and FM there is no need to tune around a band and no need to call "CQ" for a certain area. If the band is open to the part of the country you wish to make contact with you will have no problems at all. You simply transmit the tone of the repeater in that area you wish to work.

If this system is to work we will have to have some coordination, such as assigning tones and secondary 10 meter frequencies for when activity is heavy. I think the 10 meter DX links for 2 meters can be a great thing for FM. At this time several repeaters are experimenting with 10 meter DX tie ins on 29.680. I envision the day when a 2 meter operator in California can talk to another 2 meter operator in another part of the country. They could both be using small walkie-talkies. Think about this system I propose. Look into all aspects of it. I'd like to have your pro and con reactions to the idea. ... W7DXX/1

ANNOUNCING THE 73 DX-PEDITION TO BAJO NUEVO HKØ

Join Wayne Green, W2NSD/1 and Keith Lamonica, W7DXX/1 as we operate from BAJO NUEVO. Picture yourself next November operating HKØDX from a tropical island in the Caribbean. We still have room for good operators. If you would like to be part of the 73 DX-pedition to BAJO NUEVO, Call Keith, W7DXX/1 at 603-924-3873 for details. HURRY!



LETTERS

Our station here is AB8USA, Command Control Station for MARS Army in Vietnam. We've got about 25 stations over here receiving your mag each month, and it is certainly appreciated by all of them, if you can judge by the comments on the in-country net after the new issue arrives. We also get *CQ* and *QST* both of which are greeted by loud yawns on frequency.

Thanks for the article a month or two back on MARS phone patches. We were beginning to think hams had never heard of MARS for the most part. Actually, although your article implied that most stateside stations are at Army forts, there are also quite a few civilian MARS members on the air with us. For instance, AD7FTN/WA7FTN, A6VVM/W6VVM, A6PXP/W6PXP, it's really unfair to start naming them cause there are so many. The only reason they don't turn in a huge patch count is that they don't have the manpower for24 hour operation. By and large, their operating skill is as good or better than the "pros" at the Army bases.

Anyhow, keep up the fine mag, and don't skimp on the FM articles (like there was any danger of that) since I plan to get up on 2 meter when I get out of the "green machine."

Gary P Novosielski
APO San Francisco CA

We have a few 220 MHz stations going here – WA6BRC, WA6BVC, WA6IRR, WB6OPQ, WB6SUP, WB6ZOQ, WA6HIP and my own, WA6FBY. We are using the CV431A/AR transverter surplus unit, reported in the 1964 June issue of *73* as the ARC 10A.

Perhaps you can borrow a copy from a friend (or put on your scuba gear and go down in the cellar where you keep back issues. I know you store them underwater because I bought a box full).

Anyway, I got on the air for a sum total of $17.50 – how about that! Most of our thanks go to Frank W6VMY over in Saratoga for obtaining these units for us.

Bill Hahn WA6FBY
Stockton CA

On March 26, 1972, and several times since, I worked an SS station giving the call PZ1DX. I sent him a card through the Surinam bureau and received a reply from the bureau today. They state that PZ1DX is not a licensed station and the operator is a "most daring pirate." They request that I pass this information on to all SSTVers so this type of operation can be slowed down.

Jack C. Petree WB4OVX
Roanoke VA

In my opinion CW is about the only unique thing in amateur radio which still remains (since so much amateur gear is commercially made same as the CBers). In other words, if it had not been for CW, I wouldn't have been attracted to ham radio at all. After all, anyone with a good credit rating can buy radios to talk on and can make a lot of long distance telephone calls for even less money, therefore, SSB holds no particular attraction for me. At least it is not why I entered ham radio.

The cartoon on the Feb. cover was really great. I suppose it shows how *73* really feels about CW but to me its just fine. I doubt if there would be any ham radio or *73* if it were not for old guys like him.

Bill Howard WNØEQT
Des Moines IA

Amateur satellites are unique also.

CAN ANYBODY HELP?

I need your help. Twice.

1. Schematic for a link receiver model 7000. I specifically need crystal multiplier factor.

2. Schematic and/or crystal factor for an old GE model 4ER 1A3 type ER-1-A 152-162MC. Both of these pieces of gear will be used on 2 meter FM if I can find out the needed information.

Thank you for whatever help you can give.

Dean BiglerWA7IBT

MICROWAVES

Glad to see microwave feature. Keep it up. Let's get the details on these TRAPATT and IMPATT Modes into *73*. I'm interested in surplus conversions of all kinds AM –,FM, etc. I read KICLL type articles. Interest = .1-10.5 GHz.

Herb Adams
Chula Vista CA

BONUS

I would like to point out that the Larsen Antenna works well as a ¼ wave whip on six meters. I tried it on my mobile at the suggestion of a couple of the locals. The SWR on 52.525 MHz, as measured at the transmitter, is 1.2:1.

A 12 volt antenna relay with auxiliary contacts, salvaged from an old transceiver, switches the antenna and mobile speaker from one rig to the other with the flick of switch on the dash.

Many 2 meter gain antennas will not load at all on six meters. The Larsen Antenna is not only an excellent 2 meter antenna, it is truly a "six and two" mobile antenna.

John Clough W9LPO
Madison WI

Get six for the price of two.

HAMS AS INNOVATORS

As a professional who has made his living since 1928 in marine radio and crystal servicing with ham radio to relieve boredom, a few reflections to spur amateur technology may be in order.

To this observer, the current revolution in marine and commercial radio towards VHF and maximum utilization of air space thru SSB represents a constant and growing pressure from commercial interests. This force can in time seriously threaten amateur frequencies.

It behooves inspired, adventurous hams to explore the unseen borders of technology for a new transmission medium to replace SSB. Twenty years ago a technician friend had detailed a method using vacuum tubes for voice transmission using a carrier and no sidebands. In the spectrum now occupied by one sideband it would be possible to accomodate five such carriers.

The system was too ponderous using tubes but with solid state and proliferating IC's it seems the instinctive way to do it. Lacking a proper name, it's been called True Amplitude Modulation or Carrier Power Modulation. Looking at a scope you see a carrier moving up and down transmitting intelligence, with no sidebands.

The Tiny Tim tonality of SSB begs for an innovative system to restore individuality to voice channels. Here is a tip: RF is being multiplied and divided, up and down. Why not the voice frequencies! Portions of sideband speech before entering the voice coil could, in segments, be multiplied up and divided down and reinstated into the voice channel to obtain a synthesized (and restored) quality of speech not unlike pre-SSB voices on AM.

Want to bet these projects will be solved by hams before they're uncovered in research laboratories?

F.W. Anderson W7AR
Seattle WA

Usually you are right on top pretty much on amateur affairs, but maybe not quite in regard to 160 meters. Re: "The Son of 160 M."

MORE LETTERS

The 160 band is very much alive with high power outlawed so no high power boys to contend with.

I have been back on, mostly early mornings lately, for about 8 years. I operated 160 some before WW 2. For a while I was the only really active Florida station, but that has changed in the last few years. I don't chase DX myself, but some do, with some up to around 100 countries. There is much CW and, quite a bit of the AM modes, DSB full carrier and SSB SC, also a few DSB SC. The popular SSB rig is the Drake R-4, T4X combination. (SSB is AM Right?)

I did feel as you that the manufacturers should put 160 on the rigs but maybe that would make our only medium frequency band have as much qrm as the HF bands.

The only statement that I 100% disagree with is your last sentence. 160 is *already* a "Hellova band" and *is* and *has been going*.

On another matter regarding an answer to a letter from a reader. You stated that FM wasn't available on a ham communications receiver. (This may hurt, but not too much I hope.) Read Henry Radio's advertisement for the Kenwood R-599 receiver. Not only does it have 160 but FM and 2 meter FM with the optional installed inside converter. See back cover of March 72 issue. Also in some earlier *73* magazines. (I own one.)

Harold J. Tucker K4HXW
Melbourne Beach, F L

PROJECTS

Re the "Crystal Checker," 73 November 1971 issue, page 55, I recently completed this construction project and it has worked out very well. Due to supply difficulties I had to substitute RCA SK3019 for 2N3607 transistors and 1N270 diodes for 1N914, but everything worked out okay. I also substituted a vise-like arrangement (with one metallic split jaw and one insulated jaw to replace several xtal sockets since I could not seem to get a variety of sockets). Please give us more useful construction projects like this one. (cc to author Mike Kaufman K6VCI)

Vernon Jones
Kennebunk Maine

I have been on the air since January of this year. During this time I have received your magazine and another which will remain QueSTionable. I prefer *73* over the other many times for a number of reasons, but mostly because you have some really good articles and don't waste your time with 40 pages of calls who entered contests. I also like your circuit section, but how about some more real QRP transmitters (like in microwatts).

Joseph Katz WN1PHJ
Glastonbury CT

I don't think I can bear to do without another issue of *73* Magazine. I think that the $11 for two years (check enclosed) is well worth it. The humor alone is worth that much. Anyway I heard that 1973 was going to be a big year for the magazine. Please start my subscription as soon as possible.

Jefferson W. Barstow
Hancock MI

Due to the move to UK of the Manager the BE/NL/CND/UK Forces QSL Bureau will close from 6 March 1972.

All operators and Bureaus are requested to forward all cards in the future to the *German Amateur Radio Society, Box 88 MUNICH, GERMANY*.

Thanking you for your assitance.

J.T. Worrall DL2AH/G3XBA

In regard to letter on page 6 of May issue of

In regard to letter on page 6 of May issue of *73*, I wholeheartedly agree with Ron WA1PMS and his recommendation that 146.52 be used as a simplex channel and hope others will join together in urging that this be done. It seems when anyone builds a new repeater (down in this part of the country) he wants to, and does, put it on 146.34/.94 or some other transmitting frequency with .94 as receiving.

Charlie Brown WB4OOT
Cataula GA

Thought you might be interested in comments from a Mexican ham regarding reciprocal license agreements. In a conversation in Mexico City he expressed the thought that Mexico and Mexican hams have nothing to gain and much to lose if they were to grant licenses to U.S. visitors. The loss – being mowed under by U.S. operators and with so few Mexican visitors requesting operating privileges in the U.S. it seemed rather pointless. I could think of no good argument. You have to hear it to believe how quiet the Hertz are in Mexico.

L. P. Scott WB6IKM
San Marco CA

Try working an FM repeater in NYC

Getting started on 2m FM meant that I had to buy a lot of crystals. As these are very expensive here in Sweden, I ordered them from Jan Crystals, Florida.

Unfortunately I made a big mistake! I forgot to specify the parallel capacitance. Shame on me! Of course I ended up on the wrong frequency.

As I was dying to get started I returned the crystals asking them to correct these and to return to me by Air Mail. Three weeks later I had the crystals back with correct frequencies and no extra cost.

Take my advice, ALWAYS specify the parallel capacitance. If you do not know how to figure it out, enclose the circuit diagram with your order or state the type of transceiver you are using.

Thanks JAN CRYSTALS for being so cooperative!

Eskil Persson SM5CJP
SWEDEN

After reading the article in the Oct. 1971 issue, "Back to Mother Nature the Easy Way," I was delighted.

Soon, three lengths of copper pipe were in readiness for installation. The water hose was attached, along with a valve to control the water. A step-ladder was moved into place, the equipment readied, the water pressure applied.

The first results were amazing. Since the water pressure on our tap was about 90 lbs. per sq. in., an immediate fountain of mixed mud, water, plus some grass roots, ascended to a height of the operator plus about three feet. The pipe had gone down about 8 in.

Moving the lower end of the pipe to a new position, or positions, resulted in a maximum depth of about 10 inches to be reached.

The operator, wearing a garland of water, mud, and a few strands of the grass, reconsidered. By no means could the method used by WA1FHB be used in Boulder, Colo., not where we live anyway.

The clay, rocks, and boulders, underlying the thin layer of grass, is more than anything less than a diamond bit, bulldozer, or dynamite, can move.

I have been using a crowbar, post hole digger, cuss words, blisters, and whatever help can be mustered, trying to dig two holes, just three feet deep, into which I intend to put bronze screening, along with sulfate of copper crystals, to get some sort of a ground. I have a tower that needs grounding to discourage lightning from paying us a visit – indoors.

A solution to the problem has been found. Go mobile!

Ray R. Rumfelt WØMYY
Boulder CO

I make reference to your 73 circuits page in the April '72 issue wherein a crystal calibrator is described. The 1K resistors R2, R4, and R5 are not sufficient to protect the inputs of the 7400 gates from excessive voltage. This IC has an absolute maximum input voltage rating of 5.5V, which is easily exceeded due to noise or poor regulation of Vcc. This is especially likely in amateur equipment. Instead, the output of the fourth gate (pin 3) in the IC should be used as the input to pins 4, 10, and 11. The inputs to the fourth gate (pins 1 and 2) should both be grounded.

E. Douglas Jensen
St. Paul MN

STILL MORE...

I have frequently run across U.S. nationals enjoying the privileges of ham radio in foreign countries, yet it is not possible for an alien resident to find similar privileges here. It is true that a foreign licensed "ham" whose stay is non-permanent, can obtain a portable license, and while this is a step in the right direction it does nothing for the rest of us "furriners."

The whole world is now undergoing a revolutionary upheaval in thought. The old shibboleths and customs are under examination. Beliefs, customs and even fears that guided our social behavior in the past are being examined with honesty for a change and we have been startled to find how empty some of them are. None can deny that if an injustice exists, at the very least this society has tried to do something about it.

Well, here is another opportunity, for it is my conviction that an injustice is involved and the strange part about it is that neither harm nor benefit for anyone serves to perpetuate the injustice. It is probable that this prejudice towards foreigners exists merely because it had merit at one time and like the laws on spittoons, no one has taken the trouble to update the rules.

In this day and age it is a little difficult to imagine ham radio as a "cloak and dagger" arena, and, even if it were, I doubt that an alien resident would be more so inclined than anyone else.

Perhaps not many people realize that an FCC license is required to operate a car or truck telephone; a model airplane, car or boat; citizens band walkie-talkie; etc. I often wonder whether the poor "furriner" is entitled to operate his garage door opener.

Understanding is a thing we all cherish and, in this case, it seems like such a simple thing. All we ask is permission to apply for a license. This will harm no one but will benefit a few.

J.B. Dellis
Menlo Park CA

I would like to compliment you on your super FB General Study Guide. Thanks to it I will be sporting a WB2 call in a few weeks. I plan to get your Advanced class one in a week or two. According to the FCC official who administered the test to me I did very good on the exam. He refused to disclose the exact mark but still I am very happy to have passed. This is my second try at the exam. The first time I used the ARRL license Manual and Understanding Amateur Radio to study.

Congrats for a job well done. See you on 14 MHz as WB2KFG or as WB2DCS (it better be, I ordered QSL cards for WB2DCS). I have been told that you have a very unique QSL. Is it true? Any chance of a sample of *73* and/or your QSL?

Harry Linzer ex-WN2DCS
Malverne NY

I am writing in regards to the article on MARS in the May issue of your magazine, by Mr. Harry C. Simpson, W4SCF/A4SCF.

The article was well written and to my knowledge, this is the first time the Military Affiliate Radio System (MARS) has received such recognition in a National Amateur Radio Magazine.

Being connected with the Third US Army MARS program as the Command MARS Director, I certainly appreciate the fine publicity and would like to see more articles of this nature.

Harold E. Mulkey
MARS Director
Fort McPherson GA

How could you have committed such a dastardly act? The article appearing on page 37 of the May 1972 issue entitled, "How To Get The Stuff Into The House," written by Bill Lowenberg W2OOJ has probably done more to set back the program of amateur radio than any other single act since radio propagation was first discovered. No doubt the intention of W2OOJ was to assist those in the fraternity in the general up-dating and improvement of their stations. However, the simple act of putting into print the various specific methods used by we hams in the acquisition of equipment has placed a high percentage of us in a most disastrous position. Many of us have been using one or more of the various schemes outlined by Bill in his article for years with an extremely high degree of success. The terrible part of this whole thing is that the methods which have been exposed are some of the best in the average married amateur's repertoire not just some second rate ploys.

Normally, *73* arrives right along with the Woman's Home Companion, the Ladies Home Journal, Better Homes and Gardens and such other female trivia and is just thrown on the desk by my XYL. This month, it arrived without escort with the exception of a couple of my wife's credit card bills. That one chance in a million happened! Being not particularly interested in the bills, the XYL casually thumbed through the *73* while waiting for me to come home for lunch and found the article It couldn't have happened at a more improper time. I was in the process of using scheme number two (page 38) to acquire a brand new SSB mobile rig with AC and DC using my old DX-40 and some junk box material on an "even trade." She was on to me in a second and ruined five weeks of careful preparation and offhand conversation, (which, incidentally, requires a better than average memory).

She now reads all of the ham ads and knows exactly what each piece of my equipment is worth on the used market, has made inquiry at the local parts house regarding my dealings and has directed the proprietor to mail any invoices for those "little minor maintenance items" necessary to the proper operation of my station directly to the house instead of to my office. She now realizes that a two meter slot beam is not necessary for the reception of Cable TV. A complete inventory of my spare parts has been effected and I have been directed to dispose of any surplus not vital to the operation of the station with any proceeds therefrom to be credited to the household operating account. Even worse, she is now using my code tapes and records and wants to keep the DX-40 for her novice rig. I have just forked over enough cash to cover a new spring outfit, complete with matching purse and shoes and we are having two perfectly good chairs recovered.

I have been through more thorough, detailed and humiliating interrogations in the past week regarding my actions over the past 19 years and 8 months than could have been devised by the most fiendish minds of the Gestapo when at their zenith. It's worse than the disclosure of the Pentagon Papers. In the future, this black mark on the record of amateur radio should be referred to as the Lowenberg Affair.

How a fine amateur and master trout fisherman like Bill Lowenberg could so conspire with *73*, to perpetuate such a dastardly act, is beyond my comprehension. I cannot cancel my subscription because I am paid in advance for two more years and the XYL thinks your publication a most excellent magazine. A pox on you all.

Garry Owen W5MDG
Roswell NM

Would you kindly remind your readers that the frequencies: 53.10, 53.20, 53.30, 53.40 , and 53.50 MHz have been recognized by the FCC to be *Radio Control Frequencies* for those licensed radio amateurs who engage in remote control of model boats or airplanes.

It seems that interference on these frequencies is on the increase and has, often, caused loss of control, something which can be quite a catastrophe especially in the case of model airplanes which have been caused to crash.

Besides the countless hours spent in building these models the cost involved ($300- $500) in these model planes make interference a very serious problem.

Considering all the frequencies available to hams who operate for communication purposes (CW, phone, RTTY, etc.) it seems reasonable to ask them to stay clear of the above mentioned frequencies.

Furthermore, since it is impossible to build fancy receivers in the very

...AND MORE!

small space available, it would be appreciated if a reasonable guard band (say 6 kHz) could be respected.

Pierre J. Catala
Needham MA

Del Wininger (January issue) is right when he says it is not likely any move to revise the symbols of the Morse code would succeed (though his reasoning is debatable–surely the real reason is that it would be expensive and inconvenient to change such a deeply entrenched language).

But the idea of everyone sending Morse as if it consists of letters rather than words is a bad one, except at the very beginning of the learning process–learning the alphabet. Once the letters have been grasped it is surely important that words should be read as words. This is the whole difference between an expert reader and a poor reader of *any* language. Once you have learned how to read, it is easier to read "been" than it is to read "b e e n" (which is the written equivalent of letters at 20 wpm and spaces equivalent to 7 wpm). Sent in Morse code at any speed above about 5 or 6 wpm, "been" has a beautiful rhythmic sound as an integrated group, and Del's method would destroy the sound of the *word* and substitute for it a jerky succession of isolated letters with little relevance to each other.

When you are reading this text, do you "search your memory after each letter appears" in each and every word? Of course you don't, or you would never get through an issue of *73* before the next one arrived.

Unfortunately too many bugs or keyers are already set to a dot speed faster than the dashes are sent, although fully auto electronic keys have made a vast improvement in the overall picture in recent years. There are not so many W6 calls sent as . – – – . . . . . etc. these days, because the sender cannot cope with the dashes if he has the dots set too fast, so he slows the dots down to a speed he can handle.

The ratio of dots to dashes and spaces is fine in the code just the way we have it–all we have to do is send it properly, and if Ted McElroy could read standard code at 75 or 80 wpm there is no reason why lesser mortals can't manage 20 and 25.

There is a technical reason why Del's idea is unwise too. There are many filters in use for CW which ring enough to obscure the dots when sent at 45 wpm (which we would have to do to get a message through at a basic 12 wpm or so).

Candler had the right idea in setting down groups of words of progressively greater length for the pupil to "get the tune of." Rather than vary the ratio of character to space, Candler preserved the ratio and upped the speed. You will agree that if you can read a C at 25 and a Q at 25, you can read CQ as a group at 25, also simple groups like ES and RST and DE, then CONDX etc.

I would compromise with Del and propose that maybe we should leave a longer space at the end of each *word* but I am afraid that would bring an irate letter from someone saying "that would make it hard to read sentences as an entity."

What we should do in the ham fraternity is keep the code the way it is, but USE IT PROPERLY.

For example, if we think the other guy isn't hearing us too well, or that we might be missing some dots ourselves, *slow down* instead of repeating several times. Only this evening I heard a station sending "RST 569" four times, three of them wrongly and the last one on the dash paddle as a side swiper manual key. That is ridiculous. I am sure that if he had slowed the bug down to 15 wpm he could have sent it perfectly just once, and it would be enough.

Then how about finding something shorter than CQ for a general call? Like AA (.–.–) for example, or if traffic people find that confusing, some other unused short coupling.

And how about dropping the T9 on the CW report? On the few occasions it isn't T9 we could explain what it *is* like. What we should have instead of the tone report is a click report maybe!

Let's not revise the code. Let's just use it more sensibly.

Bob Eldridge VE7BS
Burnaby B.C.

I am very much pleased with the QRP articles of the February issue. I have been using a home brew solid state QRP transmitter for quite some time with very good results on CW. The TX consists of a vackar FET VFO with a two transistor isolation stage, one amplifier stage, all on 7 MHz followed by a two diodes doubler to 14 MHz which drives the final transistor; output is 800 mW, antenna is my regular triband TH6DXX on 30 ft height. I also tried 50 mW, 100 mW, 200 mW and 500 mW, all with fair to good results on 15 and 20 meters. However, my 800 mW always works well for me on 20m. I have worked numerous W's and also European stations. It s great fun to work QRP. In this country it is very hard to find any parts for transmitter use, so my TX is built with all sorts of odds and ends.

Otto W. Morroy PZ1AC
Paramaribo, Surinam

I always enjoy your publication. Your approach is refreshing and even old staunch ARRL men like myself appreciate it.

I'm a free lance writer/photographer. I came across the paragraph in the Feb. 72 issue regarding a small "independent territory between Norway and Sweden called Morokulien . . . an international refugee area . . ."

This is a put-on, Wayne. I was hoping I'd run into something and I could do a piece on this "small independent territory." The Royal Swedish Embassy advises: "There was never any real place called Morojulien in Scandinavia, only an imaginary spot somewhere in between where the two brother nations could meet and have fun – in Norwegian, "moro," in Swedish, "kul." This mysterious location existed only in a popular TV program enjoyed by Swedes and Norwegians some ten years ago . . . "

I suspect old Eric 5N2ABG, is trying to drum up a little publicity. Actually, there is no such place as Scandinavia. I note that the post office box combines both Norwegian and Swedish and I'll bet you a nickle to a herring that our OM Eric is associated with public relations someplace. Maybe they're trying to get some Lend-Lease or something.

Bob Foy K7ZHS
Kirland WA
Kirkland WA

Drat! Another rare one down the drain.

HOT GEAR

Thanks to your Hot Gear column, an honest budding amateur and the sharp eyes of another, I will be picking up my stolen HR2A soon.

W8FXX/5

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INDEX 1971

It was our intention to print a cumulative index of the past twelve years of 73 Magazine and this is why no 1971 index had appeared in print. We have received many letters requesting an index and have decided to print the 1971 portion of the index. The twelve-year list will be published separately as soon as it is complete.

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"I see they list the IN–OUT frequencies of the module under repeaters!"

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W7DXX/1

The W7DXX/1 Column is dedicated to those of you who read 73 from the back to the front. It also gives me the chance at the last word on a particular issue.

I am trying to average an hour or two per evening on 20 SSB since I have to start my DXing anew from the new QTH in Peterborough, New Hampshire. I'm running the limit to a 3 element 20 meter beam up 75 feet and the QTH is 800 feet above average terrain. A beautiful location. It's much easier to work DX from this location than from Washington State. In fact, after just a couple of days I am halfway to the 100 countries mark.

I had a very nice 45 minute chat with Ole, OY9LV, the other night on 20 SSB. He runs low power to a dipole. However, with his mountain-top QTH on Faeros Is., he puts out a very nice signal. Ole is sending me some pictures of his shack and QTH. I'll be sure to include them in a future column. I had a small chance to appreciate what many DX stations have to go through with the stateside QRM. During our 45 minute QSO dozens of stateside stations kept breaking each time we would turn it back to each other. And then, when we finally did sign, he was mobbed by hundreds. God! I couldn't live like that. By the way, W3HNK is the QSL mananger for OY9LV.

On the subject of DX, Wayne Green and I will be operating from Bajo Nuevo (HKØ) for the November 11th week end. We have room for several more good operators. If you'd like to join us on a DXpedition to a rare tropical island, get in touch with me ASAP.

I put the *73* Magazine repeater back on the air a short time ago (WA1KGO 19-79). We have a couple of solid-state two meter repeaters on the way so we should have a couple in operation from our mountain – Pack Monadnock, Peterborough. One of them, the 19-79, will have a DX tie-in to 29.680.

You would not believe the two meter activity around the northeast. Virtually, every two meter FM frequency is occupied by at least one or two repeaters. Wayne and I took a trip to our repeater site the other evening in his mobile. He runs a 20 channel transceiver with a 100 watt amplifier. Needless to say, we had a blast. The only problem was that it would take quite a while for all the repeater tails to die out each time we transmitted.

I keep a 20 meter sked with WA4JGF, WA4QXC, W4EAL, W4LQC, and several others every Saturday morning. These fellows maintain my Knoxville Repeater (W4TEA 16-76). They tell me that they are progressing well with several new projects such as several autopatch lines to different exchanges, and the DX inter-tie to 29.680. Knoxville already has a very fine repeater (K4HXD 34-94). The repeater was put up by and is maintained by George, K4HXD (known to several of his "Group" as HIS EMINENCE). HXD is suffering the same problem most repeater owners experience. I call it the 80/20 syndrome. Namely, each repeater has 80% talkers and 20% doers. It is a sad fact but most repeater users highly praise the machine they are using until help is needed. As soon as the chips are down, or the repeater for that matter, very few people are available to help. Also, George must learn to passively monitor his repeater and not take every opportunity to "hop" on frequency and criticize repeater users. Also, he must learn to do his own thinking and not let a few do the thinking for him. I am sure when HIS EMINENCE realizes that he is in the same boat as most repeater owners,

(continued on page 112)

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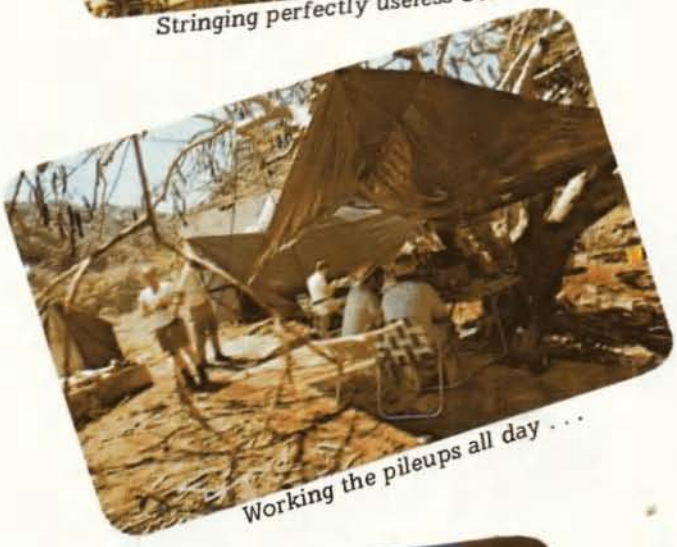
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for radio am

Visit Navassa with KC4DX
SSTV Introduction
Practical FM Repeaters
432 Receiver
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Solid state Variac replacement



Stringing perfectly useless 80m antenna



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Lush tropical Navassa Island



. . . and all night.



iffs make landing hazardous to your health



How about a nice hike?

73 magazine
for radio amateurs

#143 AUGUST 1972

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73 Magazine is published monthly by 73, Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas. $7 per year elsewhere. Two years $11 in U.S. and $12 overseas. Three years $15, and $16 overseas. Second class postage paid at Peterborough NH and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A.* *Entire contents copyright 1972 by 73 Inc., Peterborough NH 03458.* *Phone: 603-924-3873.* *It's too darned late to sign up for the 73 tour in September and include Moscow, what with the incredibly slow system they have going, but it is possible to go along and hit all other stops if you send in your $200 deposit immediately. Send for poop sheets on the tour from Lin Green, 73, Peterborough NH 03458. Don't miss the trip of a lifetime. While it looks as if the Bajo Nuevo trip is filled, there may be room for some standbys . . . see page 112 last month. Positions are open in the advertising and editorial departments for experienced amateurs, OM or YL . . . they don't pay a lot but they are fun . . . and what is more important? 73 is growing rapidly. Now stop reading this trivia and get to the articles . . . and most important, send in that readers service list. The agonies of deep personal torment will plague you if you don't send it in.*



EDITORIAL BY WAYNE GREEN

Caveat Emptor

That means buyer beware. Rather than go through long lists of problems that fellows have had with various firms, getting into a hassle over nits, perhaps a short list of who to contact for details about what firm is in order.

If you would like consumer info re: HT Specialists, also possibly known as Curtis Communications, in Willowdale, Ontario, write to Bob Coburn W1JJO, RFD 2 Tinkham Lane, Londonderry, NH 03053.

Consumer info on Herbert Gordon Company, also known as Bolton Labs, and possibly other names, Harvard, Mass., check with Charles Terry W4FZX 1300 Shady Lane, Orlando FL 32804; James Sandberg K6HE, 1138 E. Rustic Road, Escondido CA 92025; William Watts WA0SQL, 1020 Main, Durango CO 81301; Stanley Allan, R1 Box 99, Durango CO 81301; James Thurber W4ICF Box 373, Boynton Beach FL; Thea Vance, 212 Ellendale, Crown Point IN 46307; Max Fraser VE4MF, Binscarth, Manitoba; Carl Pohlner K3PZE, 1780 Joan, Balto MD 21234; Harvey Wills K6KYC, Box 462, Independence CA 93526.

There is quite a bunch of ham gear made up in Japan that is simply awful. This should not be confused with the fine gear that is being imported by reputable companies such as Standard, Drake, etc., which meet all U.S. specifications. Some of the rigs couldn't meet specs without a major rebuilding job. For instance the Standard 145, available only from Japan, and equal only in looks to the U.S. imported Standard 146, failed miserably in the *73* labs and seems like a real loser. Please watch out for anyone importing or even selling these – and watch out for anything else they are selling for if they will try and foist a 145 on you they may have no scruples about selling other useless gear.

FCC At It Again

Several of the operators using the WA6ZDI repeater in Los Angeles have received citations for signing their calls as "mobile" instead of "mobile six." Yes, this really happened. It seems so outrageous that it must be a put on, but I've seen the citations myself and an FCC engineer did really spend his time and our money enforcing this obscure and insignificant flyspeck in the amateur regulations.

Step two of the citation process has been more jolting to those using the ZDI repeater. This machine has an input of 146.61 (honestly!) and output on 147.33 (yep!) with the result that the Tech users, though they are personally transmitting within the Tech band, are being repeated out of band. This brought on more citations from our friendly citation center. The Techs involved answered the citation by pointing out that they were at all times keeping their transmissions within the Tech band. Clearly the persons cited were not in violation of 97.7(c) – yet they have received no further communications from the FCC. The result of this is that those cited are afraid to transmit on 146.61 unless they hear further. Many of those not yet cited are afraid to transmit on 146.61. It is only fair that these chaps get an answer.

When you consider how hard the crew in Washington are working to provide leadership and guidance for amateur radio, it is a shame that problems such as this are souring things at the field engineering level.

The Case for 34–94 Repeaters

Probably one of the most hysterically emotional things that I could write about would be a call for more repeaters on 34–94. I know of no way to get more FMers up tight and furious. I shall write about it.

There is no question in my mind that there is probably more unanimity of mind among FMers on the subject of there not being any more 34–94 repeaters than just about any other aspect of the field. Not only do they not want more, they passionately want the repeaters presently on 34–94 to get the hell off – and now! I'm for more 34–94 repeaters.

Before you put my swimming against the stream down to my well known perversity, would you be at all interested in some of the factors which went into my decision? Well, if you don't even *want* to know what factors are that are involved, then you do indeed have a closed mind. Okay, now you at least will give an eye to what I have to say, even though your mind may be made up, no matter what it is – right?

Consider, if you will, that there are more 34–94 repeaters around the country than any other pair. Note that I asked you to consider this, not draw conclusions from it. Consider also that virtually every transceiver on the market today comes with a 34–94 pair of crystals. There is *no* other channel pair that is generally provided with new transceivers. Does it make sense to have at least one 34–94 repeater in each area of the country?

The fly in the ointment is, of course, the inclusion of a 94 transmit crystal in most of the transceivers, making it so the 94 channel is often used for simplex operation. And, in most cases, where there is a 94 repeater, simplex gets wiped out when the repeater comes on. QRM = anger.

Okay, next step. Obviously both simplex and repeater operation on the same channel are incompatible. Which should give? Should we try to move all of those 34–94 repeaters to other channels, thus giving the buyers of transceivers no repeater to use when they first get their set? It isn't all that difficult for them to get a pair of crystals for the local repeater, so perhaps that is not an important factor. But is it any more difficult for them to get a pair of simplex crystals such as 52?

No other repeater pair comes near being as popular as 34–94. This means that the amateur who travels a bit must have several sets of crystals with him if he is going to use repeaters in the towns he visits. Be honest for a moment please – can you really say that there are *any* amateurs who do not travel? Just about all of us find ourselves in another area of the country at one time or another – and just about all of us want to be able to use a repeater when we get there.

Let's say you live in New York and you have the 13–73 channel set up for using WA2SUR. You go to Boston and you are out of business. Even if you are set up for the other New York channels such as popular WA2KEC on 40–995, you are still cold in Boston – and in Philly – and in Washington – and Chicago and so forth.

Would it really be all that painful to have a 34–94 repeater set up in each major city so visitors would have one common channel to use to get acquainted? Would it really be a big bad deal if travelling amateurs with a TR-22 and its 34–94 channel could know that they would have a channel to use wherever they were? Would it be that bad if HT-220 owners, most of whom have one and one only receive channel, could work a 34–94 repeat-

(continued on page 70)

The KC4DXpedition

Wayne Green W2NSD/1

One of the fellows on the DXpedition to Navassa was musing over what it was that made Navassa so interesting a place for a trip. Why not go to Antiqua or some other place? Navassa has the advantage over most of the other spots in the Caribbean – it is seldom hammed – it is awfully hard to get to – no one lives there – the seas are often against you – the weather is hot and the cliffs are awe inspiring. It is a lot different from going ashore on an island with a dock, moving into a nice hotel room with ice water and a restaurant, and setting up a DXpedition.



The intrepid ten, gathered around for a round of beers before going aboard for twelve hours of nausea, sickness and distress.

Ten of us met in Jamaica for the 1972 Navassa Island DXpedition. Eight of the group were from the Atlanta area, one from Philadelphia and Wayne from New Hampshire. Chaz Cone W4GKF made most of the arrangements for the trip, in between his work for IBM. The Philly man was Rick Feld K3FPY, the only dedicated CW man on the trip. Rick runs those 800 watt sound systems used by the top rock groups and swears that his hearing has not been permanently damaged.

Our captain of the Tycoon, Busha, said he had been by Navassa the day before and that the seas were very high at the time and that unless they had subsided we would not possibly be able to land. Great news. All of us managed to get aboard the 41' boat along with about fifty boxes of equipment and supplies and we putted out of Kingston harbor just before midnight. Chaz turned white moments later and assumed his permanent leader position with his head over the rail, a spot which he kept for the next twelve hours. Judging from the convulsions he ran quickly through dinner, lunch, breakfast, and midnight snack the night before before we reached the open sea. He then worked his way back through several days and was about two months back, doing everything possible to dredge up more by the time Navassa hove into view.

Chaz was not by any means alone. The seas were mighty and our little boat went up and down like a roller coaster, smashing suddenly to right o left, nosing into a giant swell, spra shooting into the air. It was a ver rough trip and the only winners wer the school of fish trailing our boat t pick up the free lunches being le behind.

Chaz Cone W4GKF of Atlanta and IBM who organized the effort and got the license, the Coast Guard permission, etc.

The gear filled all of the bunks i the cabin, leaving only a few chai



Rick Feld K3FPY from Philly, a swinging CW c with loads of anecdotes about the rock stars h works with.

and the deck for stretching out. T help more, it was grisly hot in th cabin and this helped aggravate an developing queasiness brought on b the wild ride. To help even more, an probably the most aggravating of al Neil was there bumbling with a tran



Ray Cobb K4PGM of Atlanta, the chef for t party of ten.

ceiver and making contacts. He'd lo ed up one of the fishing outriggers 75m and the mismatch was so b that he had to run about 0.5 watts keep from blowing the final tubes. I did manage to work 6Y5CB up to couple of miles DX. For some obsc reason he had not thought to bring antenna tuner.



Skip Staub K4TMA

Three of us headed for the flying bridge. It was flying around a lot too. We huddled on the seat around the helm and held on for dear life. There was just room to lie down scrunched up, but no way to stay put without grabbing for something every minute or so when the boat would take a particularly steep dive or list. We all spent the night too tired to sit up and too battered to sleep. You might call it aggravated rest. It got us in shape for the strenuous ordeal of moving the ton of gear ashore the next day.

As day broke Busha passed around some saltines for breakfast. Saltines re supposed to be the best thing for a seasick stomach. They were great – soon there were showers of saltine flakes billowing back from the boat looking for all the world like snow as

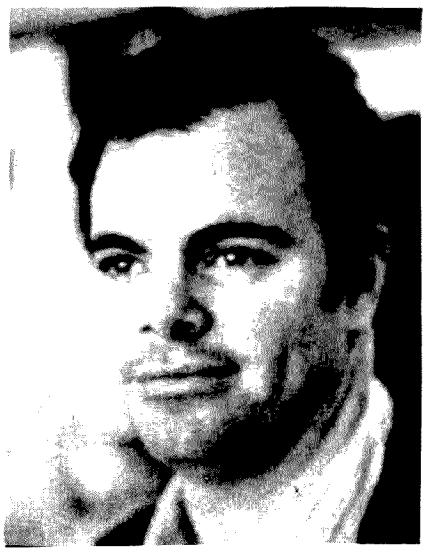


eve Smith WA4VWV, another Atlanta pilot and a rned good ham operator.

even that Spartan breakfast was rejected. The heartier stomachs settled for crackers and cheese. Even the best of constitutions were not any too stable after that shaking up.

Busha, asked every one or two minutes by the whiter members of our group, kept answering that we should see Navassa along about 9:20 AM. It is a credit to his helmsmanship and navigation that Navassa appeared dead ahead on the horizon at about 9:17. The Tycoon was making about 10 knots. It could do about double that in calm seas, but any more speed would have pounded the boat too hard.

Navassa got larger, looking like an upside down pie plate floating on the water. The plateau is about 400 feet out of the water. It is ringed by a narrow flat area which is about 75 feet up from the ocean. There are no beaches. The entire island is rocky cliffs and quite impossible to climb. The only spot where the island can be reached is a tiny indentation on the south coast called Lulu Bay where the U.S. Coast Guard has built a landing platform about 35' above the water.



Don Kasten WB4SST, a pilot, of all things. Goes right with his call letters. Don is starting a little ham business on the side to make tone encoders for FM.

There is a wire ladder hanging down from this platform. Since the cliffs are undercut from ten to thirty feet at sea level, utmost care has to be taken in approaching the ladder. One mistake and a swell can shove your dinghy under the cliff and the inrushing sea will smash it and you, spitting out the whole in a shower of spray that goes out about 30 feet.

As we approached Lulu Bay we noted with dismay that the tie down buoy which used to be there had been removed. The bottom is deep and smooth, making anchoring very difficult. The cliffs go straight down about 80 feet under the water and the bottom falls off rapidly to 300 feet or so. The seas were much too heavy for the big boat to get near the ladder and the cliffs. We would have to use the tiny dinghy to go ashore.

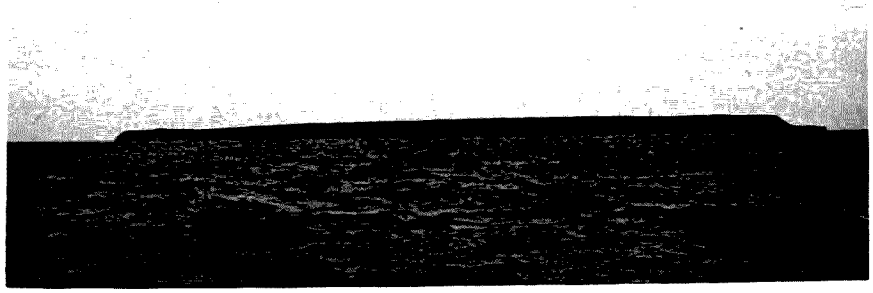
Chaz, anxious beyond all description to get his feet on solid ground, went in with the first dinghy trip. Even the spectre of the ladder, which is not at all easy to climb, didn't slow him down in his rush to get on shore.

As self-appointed official photographer for the trip I managed to get into the second trip to the ladder. After being up all night and shaken through and through for twelve hours, I was groggy but game. Somehow I got into the dinghy, meeting it coming up as the big boat went down a swell, grabbed my camera bag, and off we went to the ladder about 100 yards away.

The ladder is a bitch to climb. You have to put one leg around on one side and the other in front or else it will swing out from under you and you then have to chin yourself up the length of it; if you do it right you do get a good workout and some bruises on the legs, but at least you can make it in a minute or so instead of having to rest two or three times on the way up. Just grabbing the ladder takes coordination. If you grab it and hold on while a swell is down the next wave will come up and soak you. If



Bill Donovan WB4WMG of Atlanta.



Navassa comes up over the horizon dead ahead, proof of good navigation by the skipper.



Lulu Bay, the only landing on Navassa, a pork-chop shaped island about three miles long with no beach whatever.

you grab at the peak of a swell and don't hold tight the boat is suddenly six feet below you.

The island wasn't as steady as I wished. I made it to the top of the ladder, my cameras followed me up on a line, and I stood there gathering my wits – or at least half of them. The island was not pitching and rolling as much as the boat and that was nice. Chaz was there, a bit of color beginning to appear around the edges.

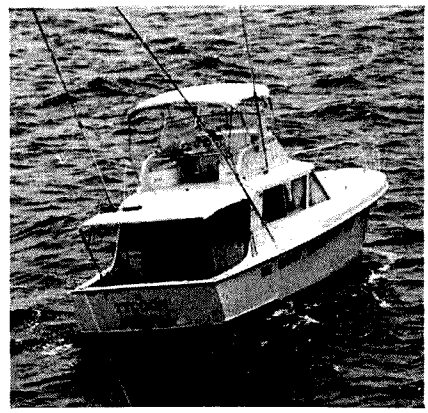
Cameras slung over my shoulder, I headed along the cliffs to get into a good spot to take pictures of the landing operation. The cactus had grown a whole lot since my last visit and I soon found myself stopped to pull off big bunches of it. Balls of cactus clung to my pants, my shoes, everything. Luckily I had worn gloves to climb the ladder and they made it easier to pry the damned stuff off. Only a few thorns went through into my fingers – and broke off.

Since I knew that the fellows would thank me in the long run if I spent most of my time taking pictures of them working rather than stopping the pictures to lend a hand pulling all that gear up the cliff, I tried to ignore the growing chorus of requests for me to come and lend a hand. You know, they reacted the same way the last time I came to Navassa! As the suggestions became a little more pointed I did some token work, huffing and puffing a lot, talking a good deal about how old I am, how often things like this lead to serious heart attacks for those unused to heavy work in the hot sun, and musing over the reaction of the 2000 or so life subscribers to *73* and their reaction if sheer laziness on the part of a couple of expedition members should cause me to expire.

I sure did get an awful lot of pictures.

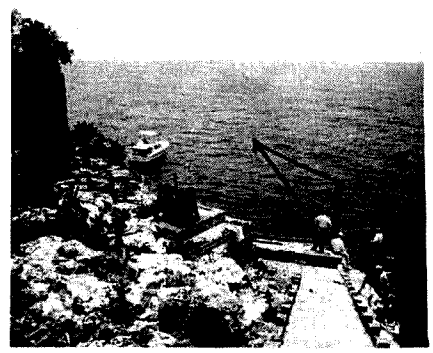
Along about 3 PM most everything was ashore that we would need and Don WB4SST was hard at work trying to decipher the instructions that came with the all band vertical antenna. The hot sun, lack of sleep, and continuous seasickness did help to make most of us a bit crabby. Neil helped with this a whole lot by issuing conflicting orders, and generally rubbing everyone the wrong way with a skilled hand.

Ray Cobb K4PGM, our gourmet cook, got his job off to a flying start by unpacking the grape jelly a little quickly. It dropped and there was Ray in grape shoes. Fortunately he had thought to bring a spare jar of jam, so all was not lost. The strawberry jam did the ten of us fine.



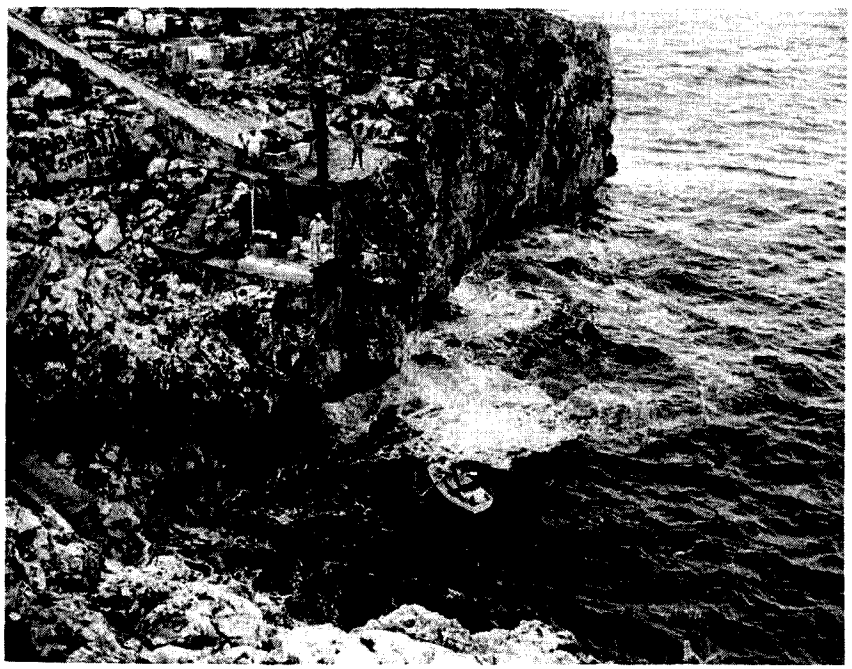
The Tycoon.

Two of the rigs were set up in short order – Heathkit sets. The triband beam was the next order of the day. It was taken out of the box and three fellows set about trying to get it together. Steve Smith WA4VWV tried to make heads and tails out of the instructions. One casting was cracked when the package was opened. The

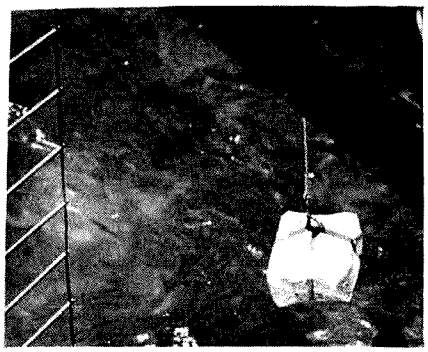


The Tycoon at anchor a couple hundred yards off from the cliffs. The loading boom and winch were rusted solidly into place and not usable, so everything had to be hauled from the dinghy to the platform by hand line.

castings which were supposed to hold the reflector and director to the boom were a little small and couldn't be fit to the boom. The cracked casting promptly broke when forced. Some tape saved the day with this. The element was taped to the boom.

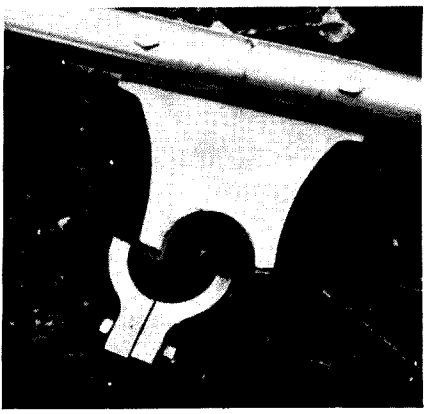


Hauling the gear and food up the cliff from the dinghy. Note graffiti all over the place such as the K4IA/KC4 on the side of the walk way and the old brick cistern building above the cliff. That gang sure must have brought a lot of paint.



One of the transceivers comes up the handline from the dinghy. Everyone held their breath hoping that nothing would go wrong at this critical stage of the game.

The worst blow of all was when Steve discovered that we had two director elements and no reflector. You can shorten a reflector and make a director out of it, but how to stretch a director? You don't. The result was a beam which we never had to turn at all. Oh, we tried turning it, but never could find out if there was any way to point it that was better than others so we just gave it up.



The casting which was supposed to hold the reflector on the tri-bander boom looked like this when we tried to fit it to the boom.

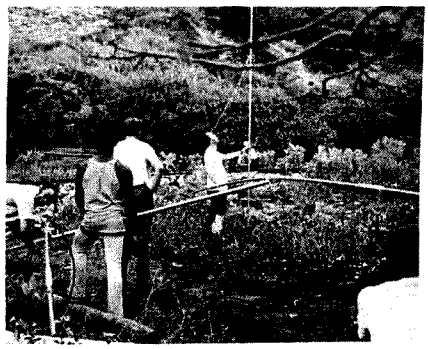
The next kick in the head was when the tribander had been assembled as best we could with the parts furnished and we put it on the end of the 18' mast. Four of us walked the mast up to about 45° when it folded at the top f the bottom section. So we ended p with a 12'' mast. This could not ave helped the beam a lot either.



So we used tape to hold the darned element to the boom. There were two directors and no reflector hipped with the antenna, so the beam didn't work.

Under Neil's direction the 75m antenna was swung a couple of feet below the beam. This had the benefit of wiping out the 75m operator whenever the tribander was being used. The 75m dipole wire was stretched out without being unwound, with the result that it took an hour or so to get the hundred or so kinks out of it. And so it went.

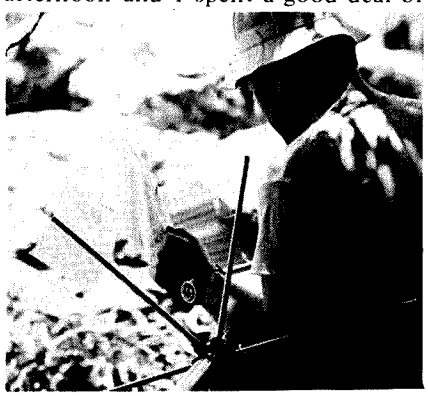
The rig that was to work with the tribander turned out not to work, so the Swan rig, which was brought as a spare, was set up in its place. Despite



Richard, one of the boat crewmen, looks on in wonder as Steve hooks coax to driven element. Others are setting up the guys for the mast – which promptly folded in half.

the antenna, it worked and the DX-pedition was on. The pileups built up immediately. All of us did a lot of operating during the weekend and most of us had a ball. It was reported that Neil had taken on the 20m CW station and had managed to work his way through 26 contacts in two hours. I found that I was running about three to five a minute on phone.

We got started operating late Friday afternoon and I spent a good deal of



Don trying to decipher the instructions for assembling the vertical.

the night operating and logging for others, mostly on 20m. I finally managed to get onto a cot set up under a big baobob tree about 5AM as it was beginning to get light. I had to coat myself with a half inch of bug repellant to keep off the swarms of mosquitos. About an hour later the first drops of rain hit me in the face. I yawned and headed to the operating area to help cover the rigs. On my last Navassa visit it had rained about ten minutes during the four days we were



Steve and Phil Latta W4GTS at work figuring out the tri-bander assembly instructions. They sure wish they'd made a practice run on this in Atlanta before getting to Navassa.

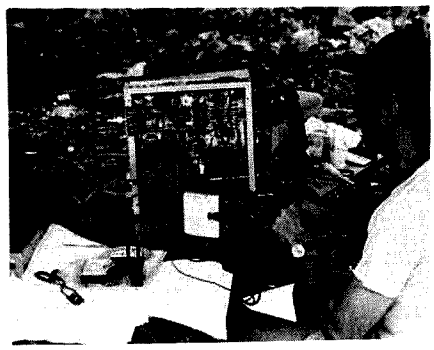
there. This time it rained a good half hour and it rained hard. So much for that night's sleep.

Neil set up a folding table as a work bench and opened up his 80 pound box of tools to see about fixing the ailing transceiver. Neil went at it fresh, having had a nice night's sleep in a tent, sleeping right on through the deluge. He needed his fresh for as he started to trouble shoot he found that



Call letters of some of previous ops were painted all over the place. It's no wonder the Coast Guard doesn't like to have hams visit Navassa. Our expedition did not paint anything whatever. Note that the KC4AF expedition in 1958 did not paint anything either.

his vtvm had gone west. He spent a good deal of the day fixing his vtvm. Fortunately he had brought along a back up vom which he used to service the vtvm. He managed to completely disassemble the unit while fixing it. We didn't hear what was actually wrong with the rig, so I suspect it was nothing serious. It was working by evening, thus missing only half of the expedition. Unfortunately, once the rig was fixed, Neil was again available to operate and the screams of anguish



About half a day was spent servicing a vtvm.

from furious operators around the world could be heard echoing forth. There was serious talk of breaking the rig again just to get him off the air.

Neil was pretty crabby most of the time. He had been frustrated over and over. He had wanted to bring along a two meter repeater and set it up so we could all keep in touch via two meters when we walked around the island. This had been vetoed when it was found that the gear would cost 58¢ a pound to ship to Jamaica. He was put out when they made him leave his spectrum analyzer and Tektronix



Chaz operating while Rick, Skip and Don look enviously on.

scope at home. He wanted to bring along one spare for everything on the trip, plus a third for backup. And so it went.

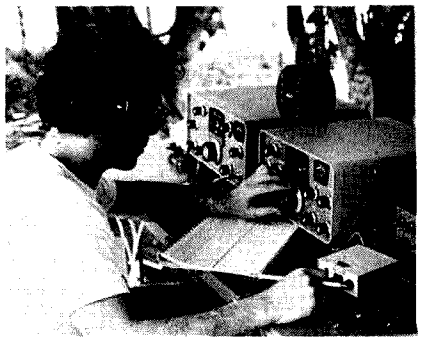
None of the fellows had been on a DXpedition before so they were not really prepared for the realities of the pileups. It is bad enough trying to handle the masses of stations that



The two generators were set up on a concrete patch that connects the landing area at Lulu Bay and the old Coast Guard acetylene building about 100 yards away. Station number two was set up right near the landing area beyond the generators.

want to work you when you have a good strong signal – when you are weak it is murder. One lousy lid with fifty watts and no brains in the States can drown you out. And once you cannot be heard there are enough idiots around to hold down your frequency for hours on end, each trying to be the very, very last in a tail-end race.

The Swan without a remote vfo made it difficult to try and work split frequency. And the weak signal made



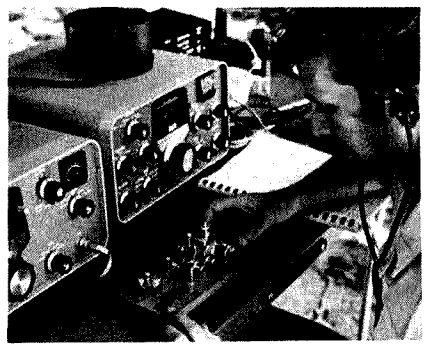
Rick took care of most of the CW activity.

it miserable to work transceive. And so it went. Most of the time I worked by call areas, starting with the WB's, then the WA's the K's and the W's. This worked pretty well. Late in the game it came to me that I could do a bit better than this if I worked say three WB's, three WA's, three K's, and three W's in each call area, working my way around the areas a lot faster than when I picked up every single WB, no matter how weak or how bumbling. Next trip I'll try that.



Chaz operating while Bill Donovan logs for him.

I managed to separate the DX stations pretty well by working them according to the number in their call. I had worked out this system in Jordan and it did well. Of course there is no real good answer to the s.o.b. who refuses to go along with this and calls without stop no matter what you say – like EA7IF. There was an HK4 and a PZ1 that drove hundreds of us up the wall too. I sure hope that Chaz does not QSL these stinkers. The next time I run an expedition there will be a place in the log to note that no QSL is to be sent for these inconsiderate



Ray took time out from cooking gourmet meals to paddle some CW.

crumbs. Yes, I know that we had a weak signal and that there are language problems – but is that an excuse for calling for an hour in spite of requests in their own language from neighboring stations to shut up and wait their turn?

One of the systems that worked very well for me and which I also developed while in Jordan was to have a couple other fellows with good signals move up or down the band and make up lists for me. This can flake



The Coleman stove had to work on regular gas instead of white gas due to a gas strike at Kingston. It managed, but had to be coddled. Here is Ray coddling the stove and coaxing it to turn out spaghetti and meat sauce.

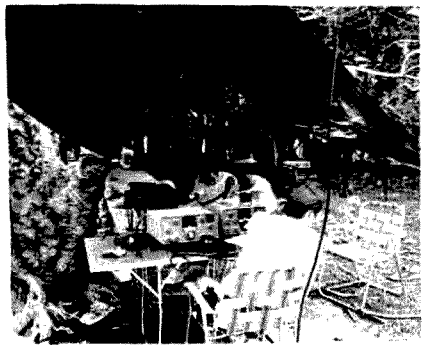
out if the band folds, but most of the time it works very well. The big problem for a DXpedition is getting the call letters through the QRM. A list fixes that.

At one time I had too many chaps making lists and I got about a hundred calls behind. This meant that some of the fellows on the list had to wait quite a long time for me to make it to them. I tried to speed everyone up as



Bill Smith has just learned that he is scheduled to log for Neil.

much as I could, but many insisted o spelling out their calls, even though already obviously had them – others gave their names and locations – etc. noticed that almost without exception that the German ops would be there even after an hour of waiting. The Japanese ops hardly ever gave up

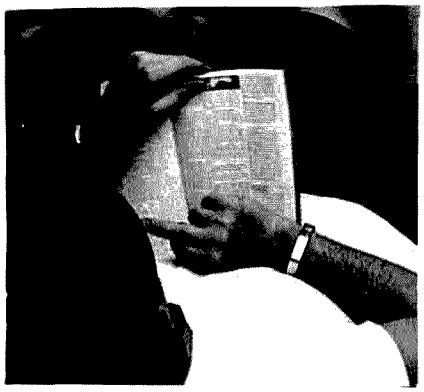


Chaz operating while Steve logs 'em in.

They were right there, no matter how long it took and I worked dozens upon dozens of them, all in the S-2 to S-5 signal range. Without the list I would have only worked a fraction of them.

The band folded to Europe on Sunday morning as I was working my way through a long list – sorry about that.

Now and then someone would get mad and put a carrier on the channel to try and spoil things for everyone. I would stop everything when this would happen and explain to the chap



73 was the favorite reading material around the camp. It was the ONLY reading material around the camp.

that all he was doing was making life miserable for the many fellows that we were contacting and that I would simply change bands to move away if he persisted. This worked every time.

During off moments on Saturday I tried to take a nap on the cot, but the flies paid no heed to the bug repellant and were perversely persistent. There was no sleep. Along about one in the morning I sacked out and fell asleep. The Sunday morning rain started in about 3 AM and I was up again, getting my daily bath. By the time we left Navassa on Monday morning I calculated that I had managed about six hours sleep total from the time I got up Thursday morning. Excitement and nervous energy kept me going. I did manage to grab an hour or so of sleep on the boat trip back.

Nothing very rare was worked during the trip. The best I managed was 7Q7AA. Very little from Africa came through. A couple of 5Z4's made it. Not much else. It was a pity that we talking about KC4DX and wondering when we would come on. Every time they turned it from one to the other I broke in yelling "break!" After a half hour of this I was close to tears. I tried moving up the band and calling CQ. Nothing. Pretty soon I heard my old friend CO2DL talking to the W4JM roundtable aha, now I'll make it. I tried again to break the group; no luck. Not once did they ever shut up and listen for a weak KC4DX on channel trying to get through to them not one time! Two



Skip threads his way between the cactus up the slope toward the plateau on a trip to the lighthouse about a mile from camp.

did not have a couple of good beams along as we had had in 1958 when I last visited the island. That time we brought two beams, rotators and towers. We worked a JT1 last trip.

A short 75m stint was more than frustrating. I enjoy working DX on 75 and I had been looking forward to knocking off a good bunch of contacts on that band. The 75m station was set up next to the tribander and every time the other rig came on the 75m receiver dropped dead com-



Typical terrain on the island. It did not encourage casual strolling around. Some of those holes went down over thirty feet!

pletely. Okay, I would have to work through the difficulty and make contacts as I could. The 75m dipole was about eight feet off the ground, so I didn't expect a lot out of it. And the rig wasn't running a lot of power. But I didn't expect what happened.

A low end of 75m was fairly clear. I heard W4JM and some others on there of our group pulled me away from the rig, calmed me a bit, and got me to go to bed to cool off. I didn't make any 75m contacts.

Slow Scan DXpedition

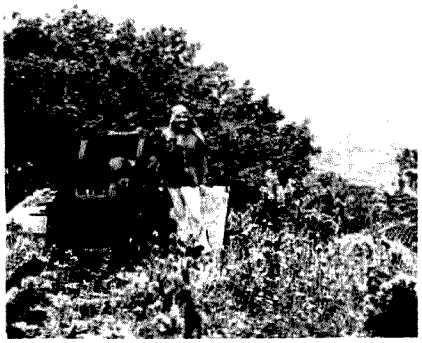
Though no one on the expedition seemed overly enthusiastic about my bringing along a little cassette recorder so we could make some slow scan television contacts, one member, Neil, resisted to the last ditch. Even though I had brought along patch cords and different types of connectors so we could connect the tape recorder into



Part of being cook is doing the dishes. Ugh!



Ostentatious show of reading 73 to sooth a crabby publisher who has had damned little sleep.



Old donkey engine left from the days of mining postash and guano on the island before WWI. Island used to be German owned, but was taken over after the first war by the U.S. Note Arab-style hat made from towel to ward off sun stroke. It's Wayne.

the mike and speaker jacks, they didn't match the ones on Neil's control consoles and there was absolutely no way that we could mate them. I found this interesting in view of his virtual radio store supply of spare tubes and parts which had enabled him to just about rebuild his VTVM the day before.

Well, no matter. Slow scan is simple to use and we don't even have to connect the recorder to the rig to make do. Before leaving home I set up a menu board with a KC4DX QSL on



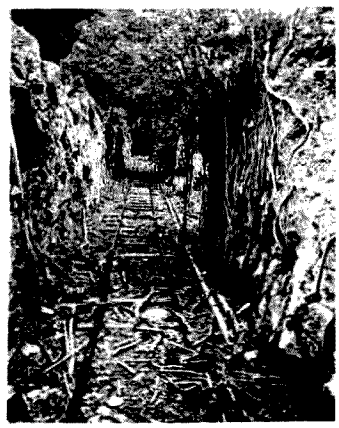
Old tracks for mining cars.

it and recorded the slow scan signal on a tape cassette. I brought along a second cassette for recording the incoming slow scan signals. Lacking the patch cords I decided just to put the transmitter mike up to the recorder speaker and do an audio patch. Ditto the recorder mike to the receiver speaker. I hadn't tried it before, but I figured it would work well enough. We weren't after perfection, only success.

I tired up one of the rigs – the one using the vertical antenna. I realized that I had a lousy signal for 10 AM Sunday morning, but that was what was available and I figured that enough fellows would want Navassa on slow scan to clear a channel. I figured wrong.

14,230 was busy with some W6TEZ and others trying to get a JA3 on slow scan. When I came on channel I was asked, not too politely, to get the hell off the channel so they could get their JA. My short fuse was lit. With bad grace I moved down a bit and worked W4MS – no strain – my pictures came through just fine. That was a relief. Eddy had no sooner made his contact for his country number 43 on slow scan than W8YEK called in. I was number 46 for Gene. I'm reasonably sure that Gene is leading in slow scan DXing.

The tape recorder system of working slow scan is not novel. Many slow scanners have only a monitor and use a tape recorded camera signal until they build or buy a scanner. Robot makes up tapes for their monitor customers – and any active slow scan-



Tracks go along cut about ten feet deep all the way across the top of the island. This facilitated their dumping guano and stuff into the cars from the surface.

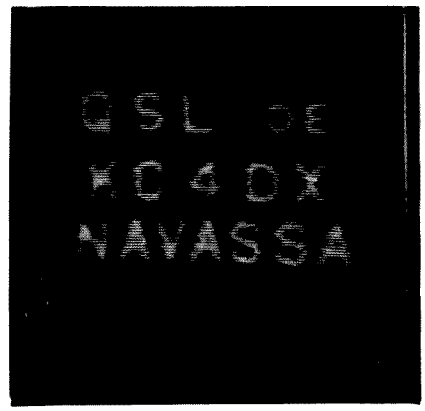
ner with a camera will help out and make tapes for newcomers. Buster W9WED uses a cassette recorder to make mobile SSTV contacts.

A few more slow scan contacts were made and I found myself out of customers. I moved back to the international slow scan channel and tried to break the group still struggling with the JA3, but to no avail. I moved back down the band and started working the thousands of sidebanders who wanted Navassa.

Late that night Glen W6KZL called on sideband and asked for a slow scan



The first glimpse of the lighthouse from the tracks.



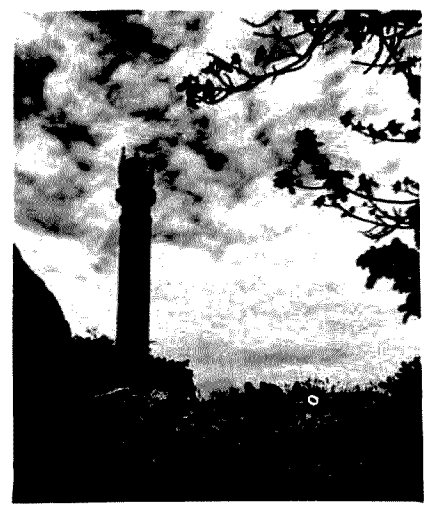
Slow scan television QSL sent from Navassa via a $17 cassette tape recorder and received by W8YEK and photographed from his monitor. The el cheapo battery operated recorder does result in slightly quivery letters.

QSO. I whipped out the recorder and inside of about a minute we had that one buttoned up. In all ten SSTV two way contacts were made from Navassa – a new first, I'm sure.

In June I'll have the recorder with me and try for some slow scan contacts from YK1AA, JY1, OD5 and possibly even SU1IM.

The incoming slow scan signals were recorded and played back when I returned home. They came out just fine! I've since replayed them on the air several times to let fellows see how they came in on Navassa.

When you consider how terribly simple it is to take along a complete



The lighthouse.

slow scan setup on a trip or a DX-pedition, it is difficult to see why this should not be part and parcel of all future unusual operations. You need no camera – you need no monitor all you need is a tape recorder. My unit was one which I bought for $17, so you don't even have to have an expensive recorder.

On Sunday afternoon Skip K4TMA, an Air Force man, and I headed up the hill toward the lighthouse. We picked a poor trail for it and soon found ourselves struggling up a 30° slope covered with what



Wayne, Bill, Chaz, Skip and Steve rest at the bottom of the lighthouse.

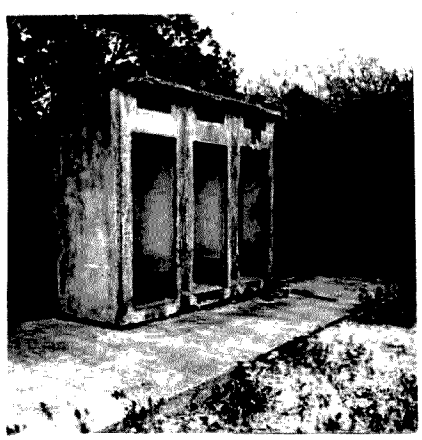
looked like meteorites and cactus. The whole island is made out of swiss-cheese type rock, like a giant solid sponge. You have to watch every step carefully for there are holes all over the place. Some are only a foot or so deep, others go down thirty or more feet and could hold a horse. One unwary step and you are in deep trouble.

We finally got to the top of the plateau which covers most of the island and were met by Chaz Steve and Bill Donovan WB4WMG who had found an easier way up following an acytelene pipeline which had been built in 1962 to power the lighthouse. The lighthouse is now run on batteries which apparently are brought in by helicopter and the pipe line was no longer used. Pity, for they sure did a lot of work putting it in. I feel sorry for the Coast Guard men that had to work at that project.

The lighthouse was firmly chained so we couldn't get into it. We did explore the old lighthouse keeper's building next to it. The roof had burned off this building in the 30's but the cistern was full right to the ground level with water. In '58 it had had water, but we had to reach down about ten feet to get it. That was the time when we ran out of our own water and had to go to the lighthouse to keep from drying up and blowing away. The water looked a little stagnant so we boiled the first batch. This was a lot of trouble so we tried a glass of it on the least popular member of the group and waited to see if he died. He didn't so we all drank it right out of the cistern from then on without bothering to boil it.

This trip we had plenty of water so we didn't have to haul it back the mile from the cistern. Our boat stayed nearby so we were able to get in a lump of ice every day and have iced drinks – luxury. On the last trip the boat dumped us and then left us alone, going to Haiti for a few days to see about a leak, so we had no further supplies possible.

Though I have no complaint about the food on this trip, some of the selections seemed strange. For instance, we had along a rather good supply of powdered eggs rather than fresh ones. I forgot to ask why. It certainly wouldn't have been much trouole to keep fresh eggs on the boat and send in a dozen with the ice every day – or two dozen, for that matter. The powdered eggs came out excellently, spiced with some of those bacon bits – you know, the synthetic bacon. I would think we could have had fresh meat the same way, but instead we had packaged beef stroganoff. Again, it was fine – no complaint. But the whole works was a curious mixture of camping out away from civilization, all the while keeping civilization (ice) with us.



World's deepest privy? With a 400 foot hole under you, it is difficult to bring the necessary concentration for proper use of this fine Navassa facility.

While at the lighthouse I made contact via two meter FM (146.94, to be precise) with the base station and from there via 20m I contacted K6CKY/4 in Virginia for, I think, the first two meter relay DXpedition QSO. Always something, eh? We didn't need the repeater for the island is small enough so there was no problem in keeping in touch via the little Drake one watt TR-22 units.

Early Monday morning we turned off the generators and packed up to leave. The number of contacts had definitely fallen off, though I am sure that we could have gone for several more days on the bands working the thousands of European and Asian stations that missed us. Perhaps some day we'll be back again – probably with a much better antenna setup and a linear amplifier to make working out easier. I don't think there was more than one chap on the trip that wasn't thinking seriously in terms of going on another DXpedition as we moved the gear back aboard the boat. It was fabulous.

With serious work in sight, I headed for the safety of the adjacent cliff and started snapping pictures of those who were working. The seas were a good deal calmer than when we arrived so the operation went quickly. Even a calm sea at Navassa is something to contend with, so it wasn't all peaches and cream. The little dinghy bounced up and down about four to six feet as it came alongside the big boat, making the transfer of people and the heavier gear chancy. No accidents.

If anyone else is thinking of going to Navassa they may be encouraged to know that we left a nice triband beam there for them. We recommend that they bring along a reflector for it and a taller mast – and perhaps a couple of castings since the sun and weather may rot out the tape in a short while. There didn't seem to be any good



After three days of much operating and little sleep Don is a little groggy. He wore the cap to fake us all out. Don is now a jet pilot with the call WB4SST.



Phil Latta W4GTS of Atlanta, as seen on Navassa.



Phil W4GTS as seen by Atlanteans.

reason for bringing the remains of that antenna back.

The ride back was a good deal easier than the trip to Navassa and many of us were able to stretch out and get some sleep, at least for a couple of hours. No sickness this time. We did burn out one engine and had to limp back at half speed for the last few hours on the other engine. We just about ran out of fuel oil too, with only a spoonfull left when we docked. The engine quit as we maneuvered into place. Luckily we had "borrowed" some fuel from a passing boat at Navassa in exchange for replacing a fuse in their radio, or we might have had to go into port out by the end of Jamaica instead of heading directly to Kingston.

We all had a quick dinner at a local department store, the only restaurant open at 10 PM, and went off to a very deep sleep. Chris 6Y5CB and his attractive wife were there to meet us and guide us around. Most of us flew back to the U.S. the next morning, though a couple stayed on with their wives for a few more days vacation. By Tuesday night I was back at *73* six days away and another memory for a lifetime for me.

The trip to Navassa was so much fun that it put me back to the map of the Caribbean to see where else a small group might go that would be fun, reasonably rare, and not too expensive. I think I've got it. Would any of you readers like to try your hand at a DXpedition this fall? How about one to Baha Nuevo (HKØ) in late October to coincide with the DX contest? I figure that the whole thing can be done for about $500 per person with ten going. We would leave from Kingston on October 25th and set up on the 26th. The big push would be on the 27-28th, and back on the 29th to Kingston – to the U.S. the 30th. One week of great fun.

This time we would have a place to sleep on the boat going over for it would take about 24 hours to sail that distance from Kingston. We would have two transceivers with beams, one with a good linear, and one spare transceiver with more modest antennas. The beams would be complete with rotators and short towers. I think I can plan the trip and arrange for the equipment. It will be hard work at times, so strength and stamina are required. Any takers?

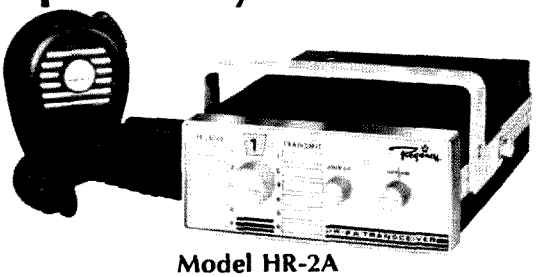
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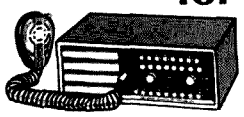
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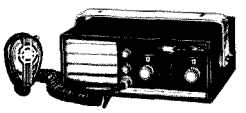


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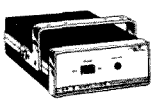
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SLOW SCAN TV: INTRODUCTION AND BASIC PRINCIPLES

You are about to enter the wonderful world of amateur slow scan television. Imagine yourself sitting in front of a radio receiver with a slow scan television monitor plugged into the headphone jack. The screen shows SMØBUO in Stockholm operating his rig from his lakeside cabin. You turn your dial to another frequency on the 20 meter band and observe WØLMD exchanging circuit diagrams with W4TB in North Carolina. These things are now possible with slow scan televsion. It has not always been this way, so let us turn the slow scan history pages back a few years to see how it all began.

In 1958, Copthorne Macdonald, a young engineering student at the University of Kentucky, began an investigation into the possibility of reducing the bandwidth of a wideband television signal to such a narrow spectrum width that it could be sent over a voice communication system. This meant that a 3 MHz television signal had to be reduced to 3 kHz signal – a 1000 to 1 reduction in bandwidth! Macdonald eventually designed a television system that met these requirements. This system used an AM subcarrier, with picture information transmitted as amplitude variations of a continuous tone of constant frequency. The old 11 meter band was used to transmit test pictures since that was the only HF band authorized for picture transmission. The AM subcarrier system proved successful, and circuit details were published in August, September *QST* (1958). Unfortunately, before the slow scan pioneers of that period could build equipment, the 11 meter band was allocated to the Citizen Band Service.

Slow scan television was now limited to frequencies of 50 MHz and above. However, under special authorization from the FCC, it was possible for Cop to perform tests on 10 meters for short periods of time. It was during one of these test periods that Cop WA2BCW, by transmitting "blind" over a period of 30 days, was successful in sending pictures across the Atlantic Ocean to John Plowman G3AST. These tests, and the pictures received in England, were described in March *QST* (1960).

Their imaginations sparked by the transatlantic tests, other amateurs soon began to explore SSTV. Soon, a small group of SSTV enthusiasts were exchanging SSTV audio tapes, and investigating a variety of circuits and standards. An FM subcarrier system was developed (January, February



Fig. I-1. Picture of W9CNW, sent from W9NTP to VK3AHR, 10,000 miles, on 20m. 2.5kHz bandwidth.

QST 1961), and it proved superior to the AM subcarrier system due to its greater immunity to interference from QRM and fading. Since none of the early experimenters were close enough geographically to exchange pictures on the 6 meter band, tests were confined to closed circuit systems, tape exchanges or transmission over phone lines.

During this time the slow scan enthusiasts were attempting to get slow scan (SSTV) permitted on the HF bands. Petition after petition was written, but no FCC action resulted. Macdonald, now WAØNLQ, enlisted the help of several hams in Washington and succeeded in getting a special test period set up at the Rocky Mountain ARRL Convention in Colorado to test the possibility of interference to other hams. W3LJV, W7FEN, WAØNLQ, W9NTP, and WØITB participated in these tests, and for three days visitors at the convention saw themselves on slow scan television either going out over the air or their image being returned over the air from far-off places via retransmitted tape-recorded pictures. It was hoped that other amateurs would hear the signals, form an opinion about their nature and interference potential and let their feelings be known through proper channels. It was during this test that the well-known picture of W9CNW, Figure 1-1, was recorded in Australia by VK3AHR with the scheduling help of W9TCT. This test was described in September 1966 *QST*.

As a result of the Rocky Mountain Convention tests, Macdonald convinced both the Navy and the FCC to authorize special SSTV tests on the HF bands. The primary goals of these tests were twofold: to improve the techniques and equipment developed for STTV, and to provide visual communications for personnel wintering over at McMurdo Sound, Antarctica. Fifteen stateside amateurs were authorized to participate in these special tests and Macdonald provided a camera and monitor to KC4USA/NØICE for use in Antarctica. Despite erratic propagation conditions, excellent pictures were often exchanged between Antarctica and the States, some of which were shown in *QST* Feb. 1967, page 77. It is interesting to note that the Navy to this day continues to support the development and use of slow scan, and has recently authorized W4ABY/NØAAJ and W4UMF/NØXTV to exchange SSTV pictures with the *S.S. Hope*.

An FCC proposal of rulemaking permitting SSTV operation on the HF bands was published in November, 1967 *QST* with one month allowed for reply. After this reply period, several amateurs – W2PMV, W9VZL/3, WAØNLQ and W9NTP – went to Washington to review the 30 letters of opposition. Very few of these letters were strong in their criticism, but some letters expressed fears that needed to be studied and resolved. After eight hours of study and discussion these amateurs spent that evening at the home of W9VZL/3 where they wrote answers to the criticisms. This small group felt sure that a slow scan television allocation was just around the corner.

At this time incentive licensing was getting quite a bit of attention by the ham world, ARRL, and the FCC. After about a year with no FCC slow scan television action, fears began to grow again. By making inquiry through the proper channels, we were told that SSTV would be a part of the incentive licensing proposal. The rest is history.

During the summer of 1968, while on a mobile DXpedition to Central America, one of your authors heard the famous words from W7FEN: "Slow scan is authorized on HF." That is how it all came about. Those of you who now enjoy the luxury of operating your slow scan gear have these early pioneers

to thank. Copthorne Macdonald is the inventor, and by his persistent interest finally perfected the system and obtained FCC action to use it.

Slow scan television can be transmitted in all of the advanced and extra portions of the amateur bands. Its bandwidth is confined to that of a voice station which is interpreted to be 3 kHz for single sideband transmission. The 160 meter band is excluded but all the phone portion of 10 meters and VHF and UHF can be used by General and higher classes of amateur licensees. It is of interest that SSTV received more band allocation from the FCC than any of the petitions ever requested.

This is the history of slow scan television. Today hundreds of amateurs throughout the world – in Russia, England, Sweden, Italy, Greece, South Africa, Colombia, Venezuela, Guadeloupe, Puerto Rico, Nicaragua, Canada, Alaska, Hawaii, New Zealand, Australia, Japan, Brazil, Southwest Africa, Belgium, Germany, the continental United States, a total of 28 countries – routinely exchange pictorial information via slow scan television on the 80 through 10 meter bands. And what started as a senior project for a young undergraduate student at the University of Kentucky is now one of the most exciting communications modes within the amateur service.

Basic Principles of Slow Scan TV

Let us explore this new amateur television that was specifically designed by hams for picture transmission on the high frequency bands. Instead of 3 MHz being available for ATV, as in UHF, we are restricted to a 3 kHz voice bandwidth in the HF amateur bands. The bandwidth of a conventional television signal must be reduced by a factor of over 1000 for slow scan. It becomes obvious that both the horizontal and vertical frame rate must be reduced to as low a frequency as possible in order to reduce the bandwidth from 3 MHz to 3 kHz. Resolution of the picture is a prime consideration in choosing the standards Home television viewers may feel that all 525 lines of commercial TV are needed for good TV pictures, but with narrow i-f's, poorly adjusted interlace and other deteriorating factors the actual resolution of a home television receiver is reduced to about 250 lines. As an example, 80 lines per MHz is the computation formula used for estimating the resolution of a 3 MHz i-f system. This is a resolution of only 240 lines. If we now consider that viewing will be done on a small cathode ray tube (available radar tubes), the tube screen size becomes a limiting factor due to beam focus. Everything being taken into consideration, 120 lines were chosen as the maximum number of lines for slow scan TV. It will be shown later that if 240 resolution lines are desired, they can be transmitted in an interlaced format for increased resolution, but such a picture cannot be viewed directly and must be photographed for the increased resolution to be realized in practice.

The vertical frame rate should be as slow as possible consistent with the storage time of the viewing tube. As far as the average ham is concerned, this means the use of a surplus P7 phosphor radar tube since available storage tubes are prohibitively expensive. Tests run over several years showed that 10 seconds was the maximum time of a frame that would permit viewing the frame on a P7 tube with a viewing hood in a normally lighted room.

It is a real advantage to use a horizontal line frequency that is related to the power line frequency. After sampling many viewer opinions and running laboratory tests it appeared that 15 Hz (i.e., 60 Hz divided by 4) was a good choice. 120 lines at 15 lines per second gives an eight-second vertical frame rate. Since these standards have been used by slow scanners in all 60 Hz power countries, it is hoped that they will be maintained indefinitely.

One thing that remains to be demonstrated is the video bandwidth of the slow scan system. Since an aspect ratio of 1:1 seems the most desirable to fit a round radar cathode ray tube, the horizontal resolution should equal the vertical resolution. There are 120 lines division in the vertical direction; therefore, there should be 120 division in the horizontal direction. This is shown in Fig. 1-1. For simplicity assume that every other spot is black alternated with white spots If these spots



Fig. 1-1. One line of slow scan TV.

are scanned, the output will be a square wave which is formed out of one black and one white spot. This waveform generates 60 complete square waves or cycles in 1/15 second or 60 x 15 = 900 Hz. This means that the maximum video bandwidth is approximately 900 Hz. This analysis is approximate, but is adequate for easy comprehension.

All that remains to be shown is the requirements of the sync pulse standards. We now have a 120 line picture being generated every eight seconds which generates a bandwidth of 900 Hz. Each line must be locked or synced, and each eight-second frame must be locked or synced. In order to choose the proper length sync pulse consideration must be given to the composite spectrum (sync, pulse and video) and how it is combined to be transmitted with good fidelity.

It has been shown that a video bandwidth of 900 Hz, is adequate to reproduce the slow scan 120 line picture. Since the line rate and frame rate is extremely low frequency, a great amount of the video energy is near zero frequency. This means that amplifiers and modulation devices must operate near the dc level. This, of course is impossible since phase shift and drift would cause much deterioration in the picture. The problem can be avoided if the 900 Hz video is modulated on to a subcarrier placed within the 3 kHz FCC allocation for slow scan televison.

This subcarrier is placed at 1500 Hz. In the early days of slow scan, the subcarrier was amplitude-modulated, but extensive testing proved that AM noise created many problems. At that time, it was decided to go

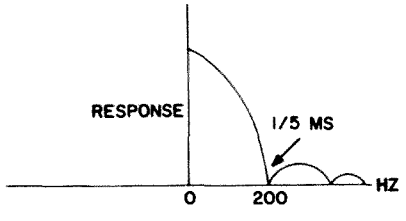


Fig. 1-2. Spectrum of video sync pulse.

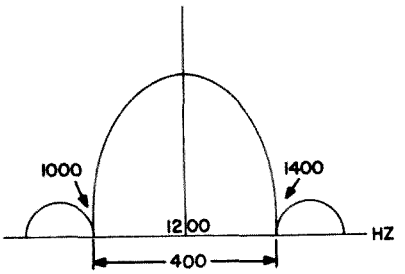


Fig. 1-3. Subcarrier spectrum of video sync pulse.

to an FM subcarrier. Today, the subcarrier operates at 1500 Hz for black video and increases in frequency to 2300 Hz for white video. These frequencies were chosen due to extensive experience with FM subcarrier facsimile transmission.

The sync frequency of 1200 Hz was chosen and represents blacker than black so that the raster is blanked during retrace. In order to separate the spectrum of the sync pulse as much as possible, the length of the pulse is made five milliseconds. Analysis showed that a five-millisecond pulse has a base video bandwidth of 200 Hz as shown in Fig. 1-2. When the sync pulse is modulated or gated on to a 1200 Hz sinewave, the bandwidth is 400 Hz, centered around 1200 Hz as shown in Fig. 1-3. Note that the major part of the sync spectrum does not fall into the major part of the video spectrum which swings upward from 1500 Hz. Finally, the vertical sync pulse is made much wider than the horizontal sync pulse in order to integrate or separate the two pulses. The vertical pulse was made 30 milliseconds long or about ½ a horizontal line. There are some who feel that this pulse should be made a bit longer. This would provide a better vertical sync pulse separation and noise immunity. Most monitors will tolerate longer vertical pulses so there is some room for experimentation on this point.

Let us review the standards for slow scan television:

	60 Hz Areas	50 Hz Areas
Horizontal line rate	15 Hz (60/4)	16 2/3 Hz (50/3)
Vertical frame rate	1/8 Hz	1/7.2 Hz
Horizontal pulse width	5 milliseconds	5 milliseconds
Vertical pulse width	30 milliseconds	30 milliseconds
Sync subcarrier frequency	1200 Hz	1200 Hz
Black frequency	1500 Hz	1500 Hz
White frequency	2300 Hz	2300 Hz
Overall transmission BW (SSB)	3000 Hz	3000 Hz

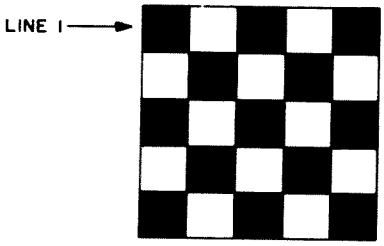


Fig. 1-4. Checkerboard pattern for slow scan transmission. The video signal and sync signals are shown in Fig. 1-5.

As a visual example of pattern generation, consider the following black and white SSTV transmission (shown in Fig. 1-4).

The video and sync signals are shown in Fig. 1-5.

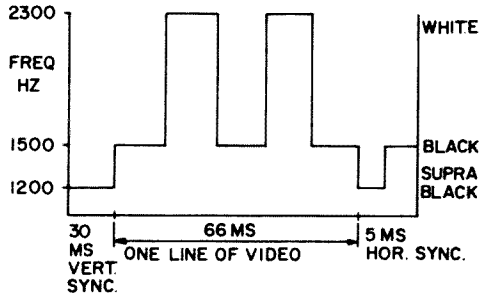


Fig. 1-5. One line of composite sync and base video.

The composite FM subcarrier signal is shown in Fig. 1-6. The composite video signal consists of a midrange audio tone ranging from 1200 to 2300 Hz and is processed in the transmitter and receiver just like a voice signal. If you doubt that a quality picture can have such a restricted bandwidth, visit a slow canner and watch pictures produced from an inexpensive cassette recorder operation at 1 7/8 r.p.s.

Most important in a slow scan television station is the monitor. The photograph of the original slow scan electrostatic monitor is shown in Fig. 1-7. This Macdonald monitor was described in March 1964 *QST*

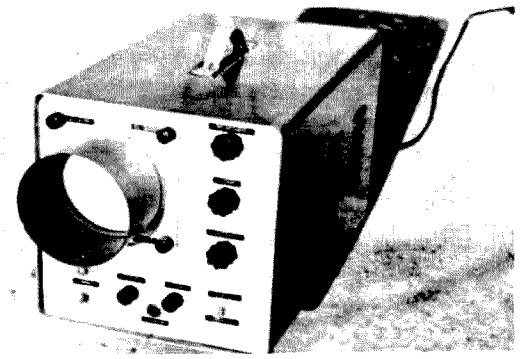


Fig. 1-7. Photograph of original Macdonald monitor (see March 1964 QST).

and this design has become the most reproduced piece of slow scan gear design ever published. This monitor has become the workhorse of slow scan TV, and it is still a favorite by slow scanners who prefer working with tubes.

The principle of all slow scan monitors is the same. Since the audio signal coming from the headphone jack of a radio receiver is audio FM, some means of FM detection must be used. A limiter is required to help eliminate much of the AM noise and QRM that is present on the HF bands. This limiter passes the clipped signal to an audio discriminator. This discriminator can be designed in several ways. The original Macdonald monitor uses a single-sided discriminator, but later in this book several other types of discriminators are described.

The discriminator changes the FM audio signal to an AM signal. It is important to note that the waveform is still made up of the subcarrier centered at about 1500 Hz. In order to recover the 1200 Hz sync signal a tuned circuit sync discriminator can be used to accentuate its amplitude so that the vertical and horizontal sync pulses can be recovered by threshold detectors.

These AM subcarrier signals will require rectification in order to produce the base

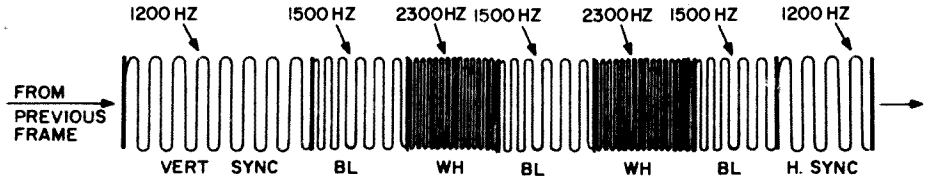


Fig. 1-6. Composite FM subcarrier modulated with composite sync and video. The composite video signal consists of a midrange audio tone ranging from 1200 to 2300 Hz and is processed in the transmitter and receiver just like a voice signal. If you doubt that a quality picture can have such a restricted bandwidth, visit a slow scanner and watch pictures produced from an inexpensive cassette recorder operating at 1 7/8 l.p.s.

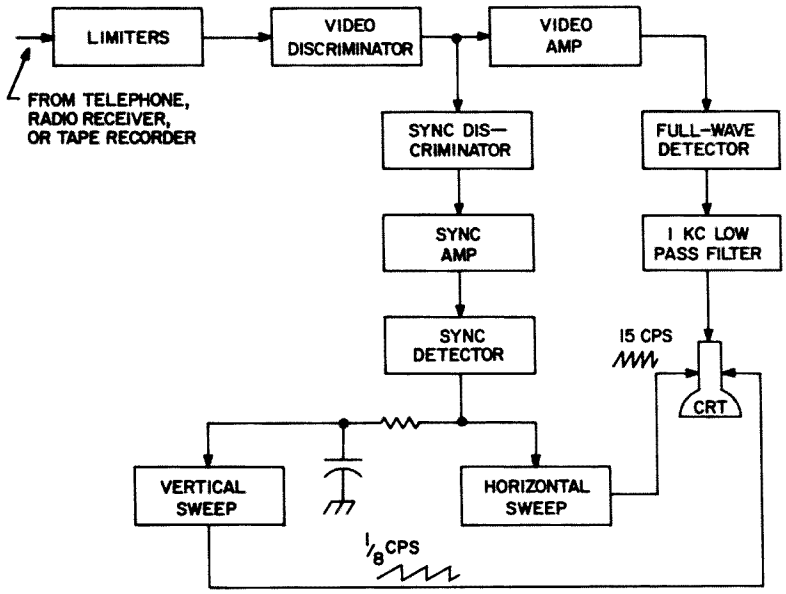


Fig. 1-8. Block diagram of a slow scan TV monitor.

video and sync signals that were generated by the slow scan camera or flying spot scanner. Usually full wave rectification is to be preferred since the low pass filter following the sync and video detector can more easily filter the subcarrier components if they have been doubled in frequency by full wave rectification.

Finally the deflection circuit (whether it is electrostatic or magnetic) is controlled by the recovered sync pulses to produce a raster on the cathode ray tube. The recovered and filtered video is now applied to the Z axis of the cathode ray tube to produce a slow scan picture. A block diagram of the slow scan monitor is shown in Fig. 1-8.

The generation of a slow scan television picture can be done in several ways. The simplest method for the transmission of slides, photographs, and circuit diagrams is the flying spot scanner. There are two designs of the flying spot scanner shown in later chapters of this book.

To utilize the flying spot camera to produce TV signals from film negatives or positives, it is necessary to generate a raster. A raster results when a sawtooth electrical signal is connected to the horizontal and vertical plates of a cathode ray tube. The two sawtooth voltages applied to the horizontal and vertical plates differ in frequency; so for one cycle of vertical deflection, several hundred deflections occur in the horizontal direction. The grid of the cathode ray tube is adjusted to produce a constant brightness spot on the face of the tube. The overall result is a white illuminated square or rectangle on the face of the tube made up of several hundred very nearly horizontal lines.

A flying spot raster on a home TV set can be produced by turning the contrast control fully counterclockwise until no trace of picture results. The brightness control is then adjusted clockwise until a white constant brightness rectangle results. This image is called a flying spot raster. A similar white rectangle is produced for slow scan television, but from different frequency sawtooth voltages. How do we produce a TV signal from this raster? It is important to remember that the raster has been synchronized in both horizontal and vertical directions by a timing circuit that starts the beginning of each sweep. The flying spot or beam is therefore in a precise location on the face of the cathode ray tube at any instant of time.

If a transparent negative or opaque positive picture is placed directly on or near the face of the tube, the light that passes through the transparency or that is reflected from the opaque photograph will be modulated by the density of the

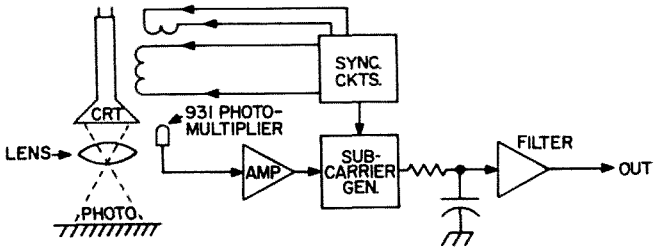


Fig. 1-9. Simple magnetic flying spot scanner.

photograph. It is now possible to place a light sensitive device (photo-multiplier) in the front of the tube, and the resulting electrical signal called video is synchronized automatically with the flying spot raster. The pulse sync signal is combined or added to the video to produce a signal that can be used to paint a picture on the screen of a distant TV set. It is important to remember that the sync signal always occurs when the beam flys back to its start during retrace; therefore, the video is not affected. A block diagram is shown in Fig. 1-9.

The principle of the flying spot scanner is useful for both fast and slow scan. Commercial TV stations have used FSS for advertising breaks. In the case of slow scan, the TV signal must be further processed before transmission. The video frequencies are so low that a subcarrier is needed to help the transmitter pass the slow scan video.

The slow scan enthusiast has several very good live cameras to choose from. Originally when Macdonald designed the shuttered 7290 slow scan camera, vidicons were given out by Westinghouse for experimental uses. Slow scan has grown greatly since it has become FCC-authorized in the Advanced and Extra class amateur phone segments.

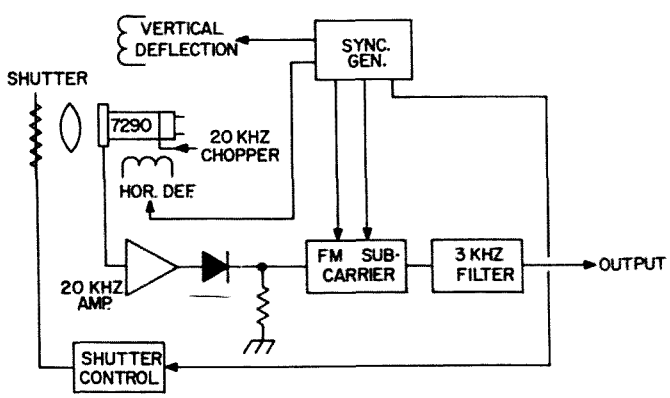


Fig. 1-10. 7290 shuttered camera.

Free vidicons are no longer available but can be purchased from the same source for $100. This price is far below the selling price of this vidicon for commercial use. The slow scan 7290 vidicon target can hold an electrical image for several seconds once it has been exposed to an image. In the 7290 SS camera shown in Fig. 1-10, an electrically-operated shutter exposes the target for about 1/30 second and then the image is electrically scanned for the next eight seconds. Similar to flying spot scanners, the vidicon beam must be swept in horizontal and vertical directions by the 15 Hz and 1/8 Hz sawtooth voltages to produce video.

The signal from the 7290 vidicon target is a very low frequency audio signal and requires much amplification. Audio frequencies near dc are very difficult to amplify because of limitations of coupling and by-pass capacitors, so a technique of chopping is used to electrically change the signal into an ac wave. A 20 kHz sine wave applied to the vidicon grid will turn the scanning beam off and on at this rate so that the small target signal can be amplified as a 20 kHz signal. Once the amplification is completed, the 20 kHz signal is rectified and the resulting signal is the amplified low frequency video or audio signal desired.

The vidicon is provided with the dc operating potentials usually needed and provision is made to blank the vertical and horizontal beam during retrace.

Due to the lack of 7290 vidicons, early slow scan pioneers tried to substitute ordinary fast scan vidicons such as the 7735A and 7038. Contrary to the opinion of those acquainted with the chemical and electrical make-up of these tubes, some slow scan hams were able to get reasonable pictures with *open shutter* operation. K7YZZ and WB8DQT have investigated this type of picture generation thoroughly, and have provided many good pictures on the slow scan net.

About this same time slow scan hams in Europe (such as SMØBUO) were successful in using plumbicons in the Macdonald circuit in the open shutter mode. This proved to be very successful and hams such as W4YHC,

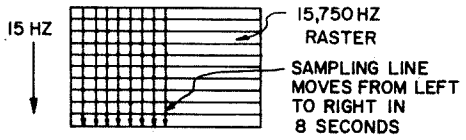


Fig. 1-11. Sampling method of producing a slow scan picture.

W7ABW WØLMD, and others have produced some excellent pictures using the Phillips plumbicon. These tubes are available as pull-outs from color cameras here in American and are available at TV stations in some parts of the country. Plumbicons, with their relatively high target resistivity are quite effective at slow scanning rates and represent an excellent alternative to the 7290 in the open shutter mode. Last but not least comes what the authors consider to be the best type of slow scan camera – the sampling camera. All of the above cameras (with the exception of the 7290 camera) require open shutter and therefore the subject being televised must remain nearly immobile for the eight seconds. In practice this is not very difficult and contributes to some of the fascination of slow scan TV in which special effects can be staged.

In principle a sampling camera operates like sampling oscilloscopes. The operating principle is based on the fact that the picture being sampled does not change over the length of time that it takes to sample moving fast scan frames. In this case, the time is eight seconds. Assume that a fast scan camera is operating with the following standards: vertical frame rate – 15 Hz, and horizontal line rate – 15,750 Hz. Note that a normal fast scan camera operates with a 60 Hz field or frame rate!

It is assumed that the video will be sampled at every line crossing as shown in Fig. 1-11.

By slowly moving the sampling point to the right at a 1/8 Hz rate, 120 vertical lines are formed. A slow scan sampled picture is generated in this way. This picture is on its side and the electrical signal needs to be filtered, but it is identical to slow scan pictures produced in other ways.

From a circuit designer's viewpoint, the functions that need to be generated in a sampling camera are as follows:

1. a 15 Hz sawtooth sweep voltage locked to 60 Hz mains.

2. A 1/8 Hz sawtooth, preferably locked to 60 Hz mains or to the 15 kHz horizontal sweep voltage.

3. A 15 kHz sawtooth to sweep the fast scan raster. This sweep does not necessarily need to be locked to other time bases and is available from the fast scan camera.

4. A circuit that provides the timing necessary to do the sampling that moves in time across the raster.

A block diagram is shown in Fig. 1-11.

Part II, next month, will cover popular SSTV circuits.

...W9NTP & WB8DQT

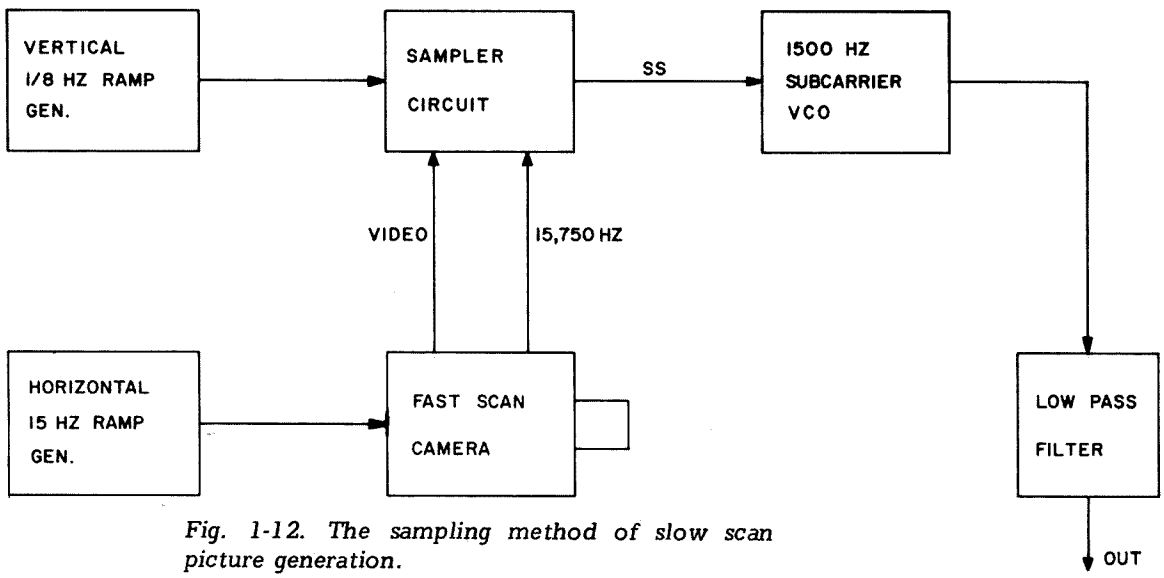


Fig. 1-12. The sampling method of slow scan picture generation.

A Versatile Premodulation Speech Processor

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Since the early 1940's, when audio clipping first appeared as a method of overmodulation prevention, premodulation speech processing has been the subject of ingenuity and controversy. As a means of increasing the "talk power" of AM transmitters, it gained considerable popularity. More recently the audio compressor has almost displaced the clipper due to its inherent low distortion. For sideband applications it has been demonstrated that heavy premodulation speech clipping is unsuitable[1],due to the transients produced by heavily clipped peaks.

While a number of systems for clipping the sideband envelope have emerged, these require either breaking into existing transmitter circuitry (unacceptable to many owners of commercial units), or the use of a complex and expensive external unit.

The simple solution for SSB operation is still the speech compressor. In the past several years the author has breadboarded just about all of the transistorized compressor circuits published in the ham press, and tried them out on the air with varying degrees of success.

The two major limitations in compression applications were found to be (a) difficulty in maintaining close to 100% average peaks without initial syllables overshooting, and causing bad flat-topping; (b) excessive mike sensitivity when using maximum compression.

Since all compressor circuits utilize some form of feedback control of gain, it follows that there is a finite time constant involved in controlling initial input peaks. Even if this "attack time" is very short, the first syllable following a pause can result in a substantially higher peak than those immediately following. If compressor output is reduced to maintain initial peaks below the 100% level, then compressed peaks will be well below the transmitter maximum output capability.

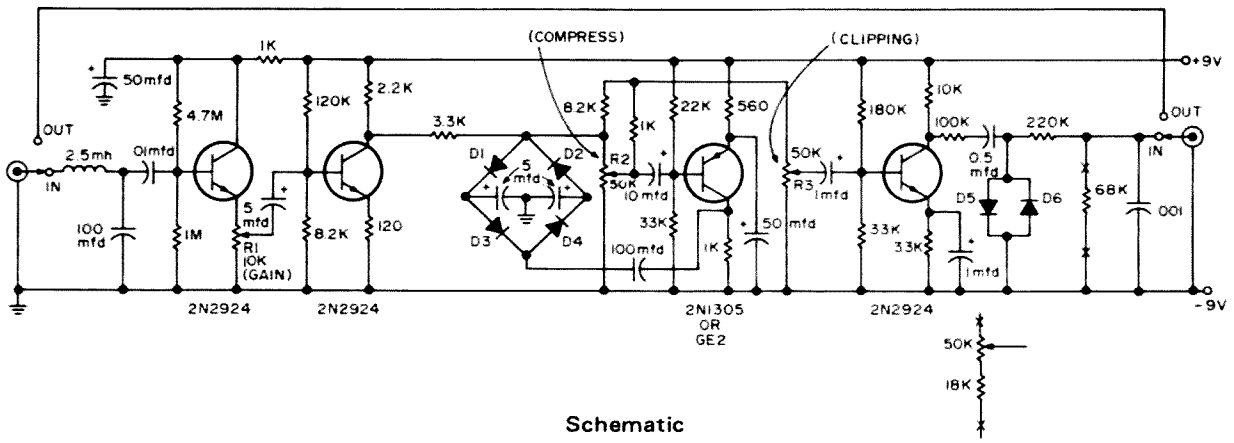
In addition, the gain of the compressor is not proportional to the input, but varies in a non-linear manner, ideally logarithmically. Thus weak sounds receive considerably more amplification and when 20 db of compression is applied, mike sensitivity will increase as much as 10 times that of normal. Unless the operator enjoys the advantage of a soundproofed studio, the resultant background noise and room echo can be very undesirable. In actual practice with the normal ham-shack environment, the amount of compression must be held well below the maximum attainable, and the benefit obtained is something less than spectacular.

Together, both the above limitations tend to reduce the effectiveness of compression. Results of trying different circuits had been disappointing in comparison to the added punch achieved with good clipping to an AM transmitter.

In reviewing both types of circuits, it was decided to try and combine the advantages of each. Actually this is not a new approach, since broadcast stations have long applied a combination of compression to maintain constant program level, followed by moderate clipping to positively limit overmodulation peaks.2 a number of published circuits were tried in different combinations, with the following performance requirements as a target:

Compression: 0 to 20 db, adjustable.
Clipping: 0 to 10 db, adjustable.
Hi-Z input and output.

The final circuit shown is based upon a



Schematic

compressor design by W. Henry[3], and a clipper circuit appearing in an issue of 73 [4]. The combination allows the optimum mix of compression plus clipping to be applied. Either compression or clipping may be used alone if desired for other than SSB applications.

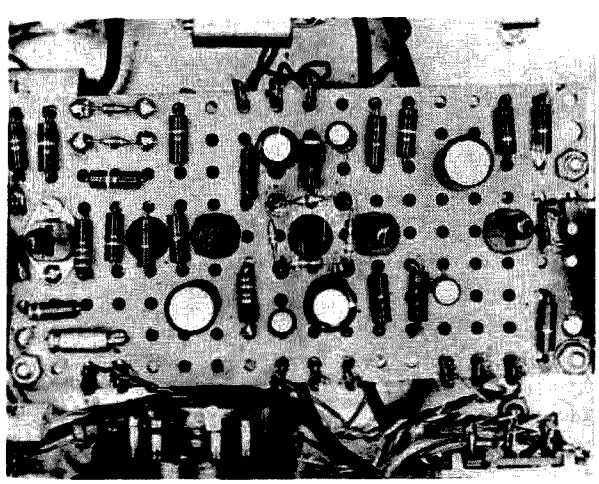
A brief review of the circuitry shows that Q1 is a conventional emitter follower, providing a theoretical input impedance of 250K. This figure will be somewhat lower, dependant upon the exact Beta of the transistor used. At any rate, it will be in excess of 100K, providing the desired load for most Hi-Z dynamic or reluctance microphones.

Q2 and Q3 comprise the compressor section, which has excellent control characteristics, while being able to handle an unusually large range of input signal without overloading. Utilizing the characteristics of diodes D1 and D2 as a variable attenuator, controlled by a DC bias current provided by D3 and D4, the wide range of attentuation available results in almost complete cut-off of output in the presence of excessively strong inputs. Q2 functions as a conventional amplifier, while Q3 provides variable control signal which is rectified by D3 and D4. A unique resistive network acting in conjunction with the compression control R2, maintains virtually constant max peak output, regardless of the setting of the compression control. Time constants in the original circuit, resulted in a release time of approximately one second, consistent with tape recording applications. Time constants were modified to produce a release time of about 100 miliseconds, in order to closely follow the syllabilic rate.

Compressed audio is fed to the inp ut of Q4 via the clipping control R3. Q4 functions as a straight amplifier raising the level to that required for clipping by diodes D5 and D6. The 100K resistor in series with the clipping diodes prevents them from loading down the output of Q4. With the clipping control set to maximu, peak output from the compressor section will be clipped about 10 db. The RC network following the diodes provides a roll-off above 2,500 hz, and filters harmonic components created by the clipping.

Construction

Most everyone has a favorite approach to the construction of a device like this, and the processor has no critical requirements as to layout, providing that normal good practices are followed. The prototype was assembled on a 5" x 2½" piece of perforated board, utilizing good mica filled transistor sockets to permit trying various transistor types. For more permanent construction, perforated board with .062" holes is recommended, using flea clips for mounting com-



ponents, including transistors. Transistors of the economy type were chosen, but other types with similar characteristics may be substituted if they are available. Diodes D1, D2, D3 and D4 should be the types shown to obtain the right attenuation characteristics. These are now inexpensive types and readily available from leading distributors. Diodes D5 and D6 are particularly recommended for their clipping capabilities, though other silicon types will work. The 2.5 mh input choke is considered a must. Some early reports of distortion prior to incorporating this choke, proved to be due to rf feedback. The additional gain of this unit makes it particularly susceptible to rf pickup on higher frequencies.

The output of the processor is about 150 mv peak, which is quite a bit higher than the average mike level. In most cases, however, this can be compensated for by the transmitter mike gain control. In those rare instances that it cannot, or if the operator desires to retain the same mike gain setting with the processor in and out of circuit, the optional output attenuator may be substituted for the 68K output resistor.

If the processor is to be used only with a microphone in the -45 db to -60 db range, input control R1, is not absolutely necessary and may be replaced with a fixed 10K ½ watt resistor. However, if high level inputs, such as phone patch or tape recorder are contemplated, the input control will be useful to prevent overdriving the base of Q2, and should be set so that no distortion occurs. For mike use the input control may be left at maximum.

The clipping control R3, and the output attenuator (if used) need only to be set up once for a given mike and transmitter. These controls may therefore be incorporated as screwdriver adjustment types, leaving only the compression control for panel adjustment, so that compression may be changed to suit individual operator voices and conditions.

Using the Processor

Much of the comment that has been heard over the air relative to the detriments and distortion resulting from use of this type of device stems, I believe, from incorrect adjustment. The chief mistake is trying to get too much by cranking in all the available compression or clipping, resulting in bassiness and degradation of speech quality. So better to start off by using too little rather than too much.

The following procedure is suggested when first setting up the processor with your mike and transmitter.

Set the processor controls as follows:

Input Gain—Max. clockwise.

Compression—Min. (fully counterclockwise)

Clipping—Max. clockwise.

Speaking into the mike with normal voice level, adjust the transmitter mike gain for normal modulation peaks. If the optional output attenuator is incorporated, then the transmitter mike gain should be left at its normal setting and the output attenuator adjusted for normal modulation. Having established the transmitter input by one of these methods, slowly rotate the clipping control counterclockwise while continuing to talk into the mike, and observe the output peaks. For a part of this rotation no change in peak swings will be noted, but a point will be reached where peaks begin to drop. This is the clipping threshold. Reset the clipping control slightly above the threshold point. Finally, advance the compression control noting that, while maximum peak swings do not increase, modulation troughs become shallower until the needle of the output indicator will "hang" within 80% of maximum. Optimum setting of the compression control will have to be determined with some experimentation, and may be varied for different conditions. As used by the author, the control is set between 12 and 3 o'clock dependent upon conditions. For local contacts the compression control may be set at minimum, leaving only the light clipping to prevent overmodulation.

Always remember that the processor is supposed to boost the weaker voice sounds and adjust for variations in speaking level, or distance from the mike. If you get reports of boominess or room noise you're overcompressing.

After you get it satisfactorily set up, you might want to increase the clipping control a bit more, but not so that obvious raspiness occurs.

Results

And now to the prime question, "What will it do for me?" No, it won't substitute for a linear or a beam, but properly adjusted it will give added punch and intelligibility that can make the difference between being poor copy or Q5 when the going gets rough. Needless to say, it adds nothing when your signal is 20 over S9.

In support of this claim I can say that the processor has been used on the air for several months, and has been subjected to many tests with other stations.

Used in conjunction with a Galaxy V Mark 2 transceiver and a Shure 444 microphone, each test has consisted of several transmissions with the processor in and out of circuit, with identical peak output being maintained on a monitorscope.

While it is obvious that no form of premodulation processing is going to increase peak output, many stations have reported an *apparent* increase of 1 to 2 S points when the processor is cut in. This is obviously caused by the AGC time constants in the receivers responding to the higher *average* signal, and has been most noticeable with receivers using audio derived AGC.

In all cases, stations worked have reported a significantly louder signal with processor in circuit. Under S2 signal conditions, 50% copy was reported without the processor, and 100% copy with it.

. . . W6AJZ

Bibliography

1. "Speech Clipping for Single Sideband"; W. K. Squires & E. T. Clegg; *QST*, July, 1964.
2. *Radiotron Designer's Handbook*, Langford-Smith, Chapter 16, 2 (vi). "Volume compression plus limiting."
3. "Tape Compressor"; Walt Henry, *Electronics Illustrated*, July, 1966.
4. "Clipper/Preamplifier"; Jim Fisk W1DTY; *73 Magazine*, March, 1967, p. 5A.

Other References

"Premodulation Speech Clipping and Filtering"; W. W. Smith W6CBX, *QST*, February, 1946.
"A Clipper-Preamp. for A. M."; Gary Blake Jordan WB6MOC; *CQ*, July, 1966.
"RF Clippers for S.S.B."; William Sabin WØIYH, *QST*, July, 1967.

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A Two Buck Signal Generator

Modulated FM yet.

The circuit in Fig. 1 is as simple a modulated transmitter as can be built. It has been useful in testing two meter FM receivers, alignment, (rf/i-f peaking) and as a short range transmitter. When used as an FM transmitter or wireless mike the range without an antenna is 100 yards plus and the audio is excellent. The components may be wired on a terminal strip or soldered to a small (2 x 2 in.) piece of copper clad board and then installed in a small minibox with the end cut out. The box will eliminate frequency shift due to hand capacitance and the open end will allow the signal to radiate directly from the tank circuit. If you must go first class, a one turn link coupled to the tank coil, one end to ground through a 5–20 pF capacitor and the other end to a pin jack will allow you to have a completely enclosed box with a plug-in whip antenna.

Construction

All leads should be kept to a minimum, and with short leads be sure to heat-sink the transistor and varactor leads when soldering. The varactor is from Poly Paks, 25¢ available in packs of four. The transistor is a Motorola MPS6512. The mike is an 89¢ lapel mike (crystal). If only an rf signal is needed for alignment purposes the mike, varactor, and 2 pF coupling capacitor may be eliminated. The coil for 147 MHz is two turns No. 16 wire ½ in. diameter and ½ in. long. A ½ x ½ in. hairpin loop will put you in the 432 MHz range. If modulation is used do not exceed the 2 pF value for coupling to the varactor.

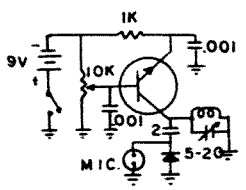


Fig. 1.

Three or four turns of hook-up wire as a gimmick capacitor works nicely. In the interest of slower tuning you may wish to parallel the tank capacitor with a small piston trimmer and use the 5–20 pF as a band set. An alternate method would be to mount the coil on a brass, slug-tuned coil form and tune with the coil slug.

Based on letters from past articles, parts appear to be a problem in some areas. I have a quantity of MPS6512 available for 90 days after this issue at 25¢ each plus an SASE.

. . .WB4MYL

W. Edmund Hood W2FEZ
229 Quincy Shore Drive
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transmitters THEN and *NOW*

I can remember, way back in the dim dark past, when I was a Novice, seeing an article by W1DBM in which he showed how an old carbon filament light bulb could generate sufficient rf to cause a troublesome level of TVI. Thinking back on that today, I can't but imagine the stir it might have caused back in the time this type of bulb was in style. Amateur transmitters in that time were weird and exciting, as well as noisy. A kilowatt rig made so much noise it had to be muffled in a special box.

Most of us like to believe that Marconi "invented" radio waves. Frankly, he didn't. He didn't even discover them. As one old-timer put it, nobody really invented these things. They were there all the time waiting to be discovered. That was the case with radio waves. Long before Marconi's parents even so much as held hands and Hertz was still toddling around in short pants, another man was hitting awfully close to the right idea.

His name was James Clark Maxwell. Born in Scotland, he was as a boy so fanatically interested in science that his schoolmates nicknamed him "Dafty." When he was barely in his teens, though, he was turning out scientific writings that made the experts sit up and take notice. As a man of forty, he had the distinction of being appointed to a professorship at Cambridge, England.

In 1873 "Dafty" came up with the startling theory that electricity and light were similar in nature, and that they were waves. Now, a wave is defined as a vibration of a substance. Sound, for instance, is the vibration of air. Maxwell had to define the substance through which light traveled.

He called the medium ether. The word ether had long been used to describe the substance of which space is composed. Maxwell accepted this theory, and offered

the theory that light waves were merely ripples in the ether. Now all he had to do was produce these ripples artificially. Only death could stop him, and it did.

Heinrich Hertz had grown to manhood by then, and was lecturing in the University of Kiel. He was intensely interested in Maxwell's theory, and there were many entries in his diary; "Thought about electromagnetic rays. . .Hard at Maxwellian electromagnetics. . .Nothing but electromagnetics." In the Kiel high school library, there were two coils of wire, each with a spark gap across it. One day, as he discharged a Leyden jar through one coil, he had a spark jump the gap in the other coil. Hertz experimented with this phenomenon for eight years. Using homemade equipment and working in the school lab after classes were over, he managed to transmit impulses over a distance of about forty feet. Small as this distance may seem, it was enough to enable Hertz to verify many of Maxwell's theories. Building huge curved mirrors and prisms, he demonstrated that the electric waves could be reflected and refracted the same as light waves. By the time he died in January, 1894, the world had a sound knowledge with which to start the development of wireless. Hertz himself had no idea of what he had started. When asked whether or not his waves would ever be used for telegraphy or telephony, he said he didn't think it would ever be practical.

Hertz's transmitter was very simple —merely a spark gap in a large loop. When another loop of the same size was nearby, a corresponding spark would jump in the receiver loop. Before it could become practical, a more sensitive receiver and a better means of producing the waves had to be developed. When Branley's coherer was developed the world was ready for Marconi.

Marconi began experimenting with Hertzian waves around 1895. He used a very similar transmitting apparatus, except that he added an antenna and ground. Much of Marconi's success, however, should be credited to Branley's coherer. It was the start of the age-old problem, "You can't work 'em if you can't hear 'em." By the spring of 1897, he had filed a patent for "signaling through space without wires." In July, 1897, the Marconi Wireless Telegraph and Signal Co. was formed, and the radio industry was on its way. Lloyds of London asked Marconi to install equipment in two lighthouses on the North Irish coast and instruct the keepers in its operation; thus the first practical use of wireless was launched.

One of Marconi's big problems was separating signals one from the other – that is, the problem of tuning. That meant that the receiver should be able to accept signals from one transmitter and reject all others—a simple enough accomplishment today, but in that day, resonance was unknown. Marconi called the condition "Syntony." With the help of Sir Oliver Lodge, who, by the way, had helped Marconi before in the development of the coherer, syntony was achieved and patented by 1900.

One of Marconi's helpers, Ambrose Fleming, had developed a receiver using a "valve." This first vacuum tube relied on a phenomenon which Edison had noticed some years before, but not patented. Fleming scooped Edison on the patent of this device, but Edison had his revenge. He had a prior patent on the aerial and Marconi had to pay for rights.

For the first couple of decades, most of the development in radio techniques was confined to receivers. Transmitters remained basically quite simple—a spark gap connected to an antenna. In Marconi's first rig, he used a transformer similar to the ignition coil of an old Model T Ford. The primary power was supplied by batteries through an interruptor similar in principle to an electric buzzer. Zinc was preferred for the electrodes, although brass or copper could also be used. One electrode was grounded, and the other connected to an antenna through a series inductance. The inductance was slide-tuned. That's all there was to it. This circuit was still around in 1920, although an old book says, "The government authorities are not inclined to grant a license to operate the transmitter in Fig. 12, unless it be of a low power and located in a region where it is not apt to interfere with the working of government or commercial stations." This was in 1920.

An improved version used an ac generator

and coupled the antenna inductively to the transmitter. The coils were still slide-tuned, although a capacitor was sometimes inserted in series to correct the aerial "if its natural wavelength exceeds 200 meters."

Most of the spark transmitters utilized an ac spark. The resulting rf was therefore modulated at the ac frequency. This made it possible to hear the signals with a crystal receiver, when they would otherwise have been inaudible. The hissing crash of the spark could be heard far from the operator's shack. The spark itself occurred between the ends of two metal bars about 1/16 to 1/8 inch apart. The bars were equipped with fins to facilitate cooling. The hot ends were generally flat, although pointed ends would spark more easily. Flat ends would quench better between cycles of the generator, giving better modulation. The generator frequency was preferred to be around 200 to 400 Hz, since operators preferred a nice musical note. As the art developed, ways were found to better govern the frequency of the spark.

One way was the rotary gap. In a rotary gap, a conductor was spun between a number of points, making and breaking the gap at a pleasant-to-hear frequency. There were two types of rotary gap, namely synchronous and nonsynchronous.

The difference was simply that the rotating member was, in one instance, mounted directly on the generator shaft, so that its spark always occurred at the peak of the generator's cycle. Of course, this required the generator to have an output frequency the same as the modulation frequency. In the cheaper nonsynchronous spark, the tone heard at the receiving end would be a composite of the gap frequency superimposed on the generator frequency. This gave a rougher note to the receiver.

Quite surprisingly, the principle of an LC resonant circuit was applied first to the step-up transformer between the generator and the gap, rather than in the rf portion. In fact, the early books seldom even show an LC resonant circuit in a transmitter until vacuum tubes entered the picture. They were, of course, used in receivers almost from the beginning.

One other form of the spark gap was the multiplace, or "quenched" gap. This consisted of a number of copper disks, separated by insulating washers, mounted between the electrodes. While this was a more efficient rf generator, it lacked the musical sound of the rotary gaps. However, if the power supply was at a high enough frequency, it was quite satisfactory.

Finally, it is worth mentioning that every radio shack had a "test buzzer." This was a common electric buzzer, sometimes equipped with a tuned circuit, which could be connected to an antenna. Its function was the same as signal generators in today's radio-TV repair shop. The buzzers were quite efficient. One account states that, when connected to an antenna, they could be picked up several miles away.

Most of the tuning of these early transmitters was done inductively. In the earliest models, the main frequency-determining element was the antenna, together with an inductance at the transmitter end. One interesting sidelight is the use of the centimeter as a unit of inductance. One centimeter equaled 0.001 μH. Eventually, as the state of the art improved, and the nature of radio signals was better understood, capacitors began to be used. They were first used in receivers, though, and for good reason. The voltage required to produce a good reliable spark ran well up into five figures, and even today you can seldom find a capacitor that will withstand that kind of voltage.

Around 1903, a Danish engineer by the name of Valdemar Poulsen tackled one of the hairiest problems in this fast-growing art. Spark transmitters, you will remember, were powered either by an interrupted direct current or by alternating current. With each pulse of the direct current, or with each half cycle of the alternating current the rf would appear as a series of damped waves. While this served to make the signal audible, it nonetheless wasted a lot of power and rapidly lost its readability as the distance increased.

Poulsen's approach to the problem was to devise a gas-enclosed dc arc. Now, here one should realize that there is a difference

between an arc and a spark. A spark is a sudden, discontinuous discharge, while an arc is a sustained discharge. An arc needs a high dc voltage to start it, and can then be sustained by a comparatively lower voltage, while a spark is constantly making and breaking at the supply frequency. The Poulsen arc, then, used direct current, and operated at a slightly lower voltage than the spark transmitters. Being a dc arc, it could not be keyed on and off, because it could not be broken and restruck fast enough. Poulsen answered this by having the key short a portion of the tuning coil, introducing frequency-shift keying. The Poulsen arc produced a nearly continuous wave. With no modulation on the signal, it couldn't be heard with the conventional receivers of that time. This bug was, strangely enough, tackled at the receiver end. A device called a "ticker" opened and closed the circuit to the earphone several times a second so that the dc level resulting from rectification of an unmodulated signal was broken to produce a buzzing sound. Then a man by the name of Reginald Fessenden came onto the scene.

Fessenden began with what was intended to be an improvement to receivers, and ended up revolutionizing the entire field of radio communication. His first idea was to make an undamped radio signal, as a pure continuous wave was called, audible by injecting another signal into the receiver at a frequency a few hundred cycles removed from the incoming signal, thereby producing an audible sound. He called it the "heterodyne." Utilizing the same principle, he then tried injecting the audio signal at the transmitter end. From here the next step was obvious—to inject the human voice in the same way.

In 1900, just five years after Marconi had sent his first CW message, Fessenden succeeded in transmitting the human voice between two fifty foot antennas a mile apart. Ever try to modulate a spark? Probably not, but if you imagine the problems that could you can get some idea of what Fessenden was up against. True, he did transmit a voice, but the buzz on the signal nearly overwhelmed it. Even with a Poulsen arc there was just too much noise on the signal. If Fessenden was to succeed, he needed a device that would produce radio signals which were perfectly clean, so far as noise is concerned, and at a high enough frequency. He had set his sights on 100 kHz.

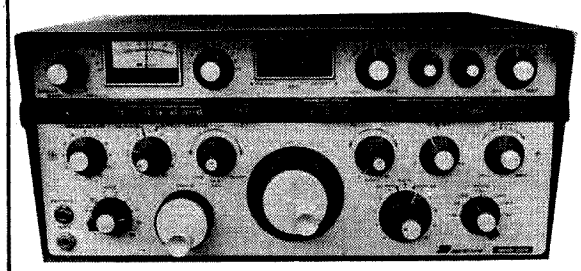
Fessenden had to wait until 1906 before he could progress any further. Until then, there just wasn't any such thing as a generator of pure rf signals. But in 1906 Dr. Ernst Alexanderson, working for General Electric, developed an alternating current generator with a very high speed rotor and a great many pole pieces. It put out a frequency of 50 kHz. Fessenden had wanted twice that number, but he had been disappointed so many times he was ready to try anything. By December of 1906 he felt it was ready for a demonstration.

The demonstration itself took place on Christmas Eve. Fessenden had passed the word around beforehand through scientific circles, and a few curious but skeptical witnesses gathered in his shack. He began in a fairly innocent manner by sending out a CQ in code. Listeners on land and at sea waited for the code signals they expected to follow. They received an unprecendented jolt. Fessenden picked up the mike and identified himself. Then a gramophone record of Handel's Largo was started up, with the horn pointing into the microphone (The world's first D.J.) After the record was over, Fessenden played a violin solo, and sang, "O Holy Night."

Fessenden himself said he wasn't much of a singer, but no singer before him ever created such a stir. Our generation was deeply inspired on Christmas Eve 1968 by hearing an astronaut read the Bible from the moon, but it was nothing compared to the thrill experienced by the many amateurs and ship's radio operators as they heard this hymn coming out of the ether, which heretofore had carried the harsh raucous buzz of morse code, at this very nostalgic and sacred time of the year. Formality and protocol went down the drain as many a ship's sparks shouted to the captain to come and hear this miraculous voice. One operator, probably a little lonesome for home, entered into the log that he had heard

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an angel singing in the ether on Christmas Eve.

The broadcast was a howling success. Letters started pouring in from listeners hundreds of miles away. The learned scientist repeated his broadcast again on New Year's day. So the ice at last had been broken. But there were still many obstacles to overcome. For one thing, there was only so much available frequency spectrum. Fessenden's Alexanderson alternator couldn't go over 50 or so kHz. Before voice transmission could become practical, higher frequencies had to be achieved with a pure continuous wave, and there just wasn't any generator capable of doing it. The world was ready for Lee DeForest.

When Edison stumbled upon thermionic emission in 1893, he simply jotted it down in his notebook and forgot it. His young assistant, Ambrose Fleming, didn't, however and upon discovering its effectiveness in detecting radio signals, patented it in his own name. Fleming was, at the time, working for Marconi, and would not license his valve in this country. American ingenuity was faced with a real challenge. At first the challenge was met by several types of crystal detectors, but then DeForest invented the vacuum tube.

All DeForest knew was that he had produced a better detector. But in 1910, Edwin H. Armstrong, while experimenting with DeForest's "audion," inadvertently completed a feedback loop in the proper phase, and noticed a whistling sound in the earphones as he tuned over a station. Could it be possible that the audion was generating radio signals? It was. Armstrong had discovered it, but somehow DeForest got the patent.

In this sort of thing, however, patents don't mean that much. It is better to say that new circuits were discovered rather than invented. As fast as an experimenter could come up with a new configuration, he would take out a patent. Hartly, Colpitts, it goes on and on. The only really new thing was crystal control of frequency, discovered by Pierce around 1917. Except for that, progress has just been a refinement of what we already had.

. . .W2FEZ

Glen E. Zook, K9STH
818 Brentwood Ln.
Richardson, Tx 7508

PRACTICAL AMATEUR FM REPEATERS

Amateur FM repeater activity in the United States is growing with leaps and bounds. Most major metropolitan centers now have repeaters operating on 6, 2, and 3/4 meter bands. The most popular frequencies are 146.34 MHz input and 146.94 MHz output or 146.16 MHz input and 146.76 MHz output. Other repeaters operate on the six and 432 MHz bands. Most of these repeaters are maintained by a small, dedicated group of amateurs who act in behalf of a larger group who use the repeater. In other areas there are groups who are interested in establishing a repeater but do not have sufficient information upon which to base their efforts. This is an attempt to fill this void.

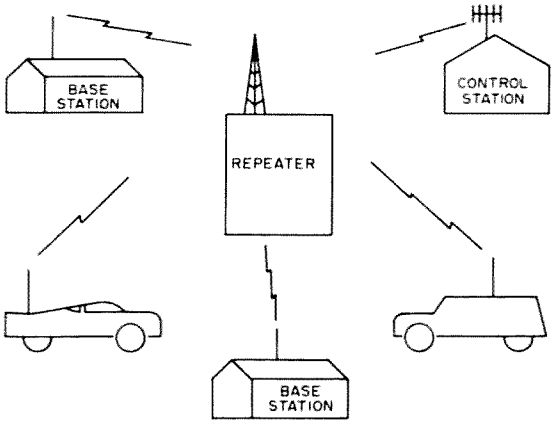


Fig. 1. Repeater operation.

Since each locale will have its own preference as to bands, locations, and available equipment I will deal in broad terms where possible. Specific mentions of equipment will refer only to equipment manufactured by Motorola Communications and Electronics, Inc. This specialization as to references is for two reasons: I am more familiar with Motorola equipment than any other brand; and, because Motorola is now releasing large quantities of equipment to the amateur market in certain areas.[1]

Types of Repeaters

The types of repeaters may be divided and subdivided into several areas: The first division is whether the repeater is an open or closed system. In an open system any carrier on the proper input frequency will key the repeater. This allows access by any amateur to the repeater. In a closed system some type of actuating signal is required to

1. Motorola is releasing to amateurs from the Atlanta, Georgia, Dallas, Texas, offices directly, and in Chicago, Illinois through a subcontractor. Conditions of sale require a photographic copy of the amateur license, a signed statement that the equipment will be used exclusively for amateur operation and not resold for commercial use. Also, only two units of a particular model will be sold to any one individual. Serial numbers are recorded so that if any equipment is returned to commercial service the offending amateur will be known.

operate the repeater when a signal is transmitted on the proper input frequency. This signal usually consists of either a single tone[2] sent at the beginning of each transmission or a low frequency continuous tone transmitted with the input signal (e.g. Motorola's "Private Line" or General Electric's "Channel Guard" systems). In the single tone system a tone decoder actuates a relay which then allows the repeater receiver to operate normally until the signal stops. At this time the system resets and a short single tone is again needed to actuate the system. In the continuous time system a low frequency tone (usually below 200 Hz) is continuously transmitted with the input signal. This tone is decoded by a reed resonant system and the repeater receiver then operates. The former system (single tone) does not require resonant reeds (L-C or R-C networks will suffice) whereas the latter system requires reeds both in the transmitter and receiver which have tolerances of less than 0.5% or better. Since these reeds are comparatively expensive, most amateur closed repeater systems use the single tone system.

Once the decision has been made to operate either a open or closed repeater, the second subdivision of types comes into play. Is the repeater to be of the on-site or of the split-site variety? The on-site system requires that the input receiver and the output transmitter be at the same location. In the split-site system the input receiver is located at some distant point and connected to the output transmitter by either a radio link or a wire line. Each system has its good points.

The split-site system is best when the input and output frequencies are to be close spaced (e.g. 100 Hz low band-6 Meter systems) or when a high power transmitter such as a 250 watt output unit is to be used. The major drawback to this system is that some type of control link must be maintained between the transmitter and receiver sites. This may be either a wire line leased from the telephone company or a radio link on 220 MHz or 440 MHz. The wire lines are expensive, and the radio links must each have a seperate radio control system to comply with FCC regulations. Also, because the transmitter and receiver sites will not have the same geography the radiation patterns will be different. This sometimes results in transmitter "dead spots" where the receiver is hearing and receiver "dead spots" in locations where the repeater transmitter is strong.

The on-site repeater systems place the equipment at one central spot for easier servicing. This is of great help when the system needs repair. When all equipment is at one spot only one team is required to service, maintain, or repair the equipment. Since the location is the same, the antenna radiation patterns will be similar when the same type of antenna is used for both transmitting and receiving. In fact, in sophisticated systems a hybrid-ring type of antenna coupler may be used to allow simultaneous receiving and transmitting on the same transmitting antenna. The drawbacks are that extensive shielding must be used on both the transmitter and receiver (details on this will be covered later) and that tuned cavities must be used in the receiver and transmitter antenna leads (more on cavities later). Also, the noise induced into the receiver will have a degrading effect [2]. This noise is partially overcome by the cavities, but some still remains.

No matter which type of system is chosen, the transmitting power and receiver sensitivity should be balanced so that a properly operating mobile station will be able to talk into the system about as far as it can be heard. This can usually be accomplished by varying the transmitter power level. The perfect system would allow talk-back and hear ranges to be exactly equal. Since this is impossible to achieve, it is then desirable to set the transmitter power a little higher than needed to cover "dead spots" within the normal range of the system.

Choosing the Equipment

The equipment chosen to be used at the repeater site(s) depends upon several things:

2. Wolf, S.M., *FM Schematic Digest*, Two-Way Radio Engineers, Inc., Boston, Mass., pp 91–92.

3. Murphy, J.A., "Receiving System Degradation in FM Repeaters," *Ham Radio*, May 1969, pp. 36–39.

The band to be used, power level required, physical characteristics of the site, type of control link, etc. Of course in different areas different types of equipment will be available. Whenever possible, choose the newest model which will do the job. This is a matter of common sense, for the older a piece of equipment the more chance for failure. It is often desirable to choose a transmitter with power handling capabilities greater than the system requires. For example, if the system design calls for a 30 watt output transmitter, chose a 50 or 60 watt output unit. This allows the unit to be operated far below the maximum ratings, thus allowing greater tube life and increasing the reliability of the system. If the site is enclosed (building, etc.) a weatherproof enclosure is not needed. A standard rack cabinet, mobile housing, etc. may be satisfactory. If the site is exposed, a weatherproof cabinet or rack must be employed. Most of the major manufacturers of FM equipment use such housings and they are available at reasonable cost on the used market. If possible, choose a site with an existing structure to support the antenna. The site may be a tall building, radio or TV transmitting tower, amateur tower, etc. Only if absolutely necessary should a tower be installed for the repeater. Satisfactory towers are expensive, hard to install, and must be adequately maintained.

FCC regulations require some type of control on each transmitting site. This includes link transmitters in the case of split site repeaters. This control may be maintained by either wire or radio above 220 MHz. Because of this, it is necessary to include equipment for maintining complete control capabilities.

A list of equipment absolutely needed at the repeater site(s) follows:

1. Receiver for input frequency
2. Transmitter for output frequency
3. Antennas for above
4. Receiving cavity (especially at on-site locations)
5. Transmitting cavity
6. AC Power Supplies for all equipment
7. Suitable housing for all equipment
8. Control equipment including:
   A. Tone actuated relays
   B. Wire line coupling equipment or
   C. Radio receiver for control link
9. Squelch relays for each receiver (COR)
10. Timer which may be adjusted for 3 minutes or less
11. ID system either voice or MCW
12. Link transmitter for split-site systems
13. AC power line to handle the load
14. Miscellaneous cables power and rf

Desirable maintainence equipment is as follows:

1. Signal generator with attenuator calibrated in microvolts
2. Wattmeter with known accuracy at the desired frequency
3. Frequency standards[4]
4. Deviation measuring equipment[5]
5. Test set or metering panel if Motorola equipment[6]
6. Complete set of spare transmitter and receiver strips
7. Extra set of crystals
8. VOM or VTVM
9. Small tools
10. Dummy load (usually 50Ω)

Setting Up the Repeater

Once the equipment has been chosen, the next step is to set up the repeater in a convenient location (garage?) for assembly and initial checkout. Each piece of equipment should be individually checked out, retuned for the repeater frequency, and then given an extended "shakedown" run. If the repeater is to be of the on-site type it will be necessary to completely shield the transmitter and receiver strips. Again the major manufacturers can provide a shielding kit for this purpose. However, the same can usually be made at a lower cost by the amateur group. Such a shielding kit normally consists of a "cane" metal enclosure which completely surrounds each unit. All power leads must be bypassed by the use of series chokes and disc capacitors. In cases where the power is brought into the unit through a single power plug an adaptor may be made that goes from the shielding to the chassis

4. Such as TS323, Gertsh FM3, Lampkin 105, etc.
5. Zook, G.E., 'Now You Too Can Have A Deviation Meter," 73, August 1969, pp 96–97.
6. Zook, G.E., 'Add-On FM Test Set," 73, December 1968, pp 18–19.

plug and which includes the needed bypass circuitry.[7]

If the repeater is to be of the on-site variety, cavities will probably be needed for both the receiver and transmitter. These cavities may be bought, scrounged, or constructed.[8] The purpose of these cavities is to isolate the receiver from the transmitter and thus reduce the degrading of receiver sensitivity. In split-site systems cavities may be desirable to reduce interference from other services located at or near the site.

AC power supplies are an obvious necessity. Many supplies built by Motorola, RCA, GE, and others will operate one or more receivers as well as the transmitter. These supplies are highly reliable. However, many older units use tube type rectifiers for the transmitter high voltage. These may be substituted by silicon diode arrays which give better reliability and cooler operation. If commercial supplies are not available, then construct the supplies using the best transformers, capacitors, and solid state circuitry available. The Motorola P8434 (30 watt output transmitters) and P8464 (60 watt transmitters) power supplies are good examples of the commercial units available.

Suitable housings depend, as mentioned before, on the physical characteristics of the site. If the unit is to be housed inside of a building, such as the elevator room of an apartment building, a cabinet rack will provide sufficient room for the transmitter, receiver, control links, etc. If the repeater must be exposed, such as on a tower or building roof, a weatherproof housing must be used. Such housings are commonly used by the major manufacturers. Special housings for pole or tower mounting are also common and may be obtained if the application requires. If a housing must be built, use the best materials available. Remember that ventilation is required, but that ventilation holes must also be weatherproof.

Since FCC regulations require 24 hour control of any remote station it is necessary to provide a control system. This control system may be either by leased wire line or radio control above 220 MHz utilizing directional antennas. In the case of wire line, units are available from the manufacturers for such applications. However, wire lines are expensive. Thus, most amateur repeaters utilize a radio control link. With the "splitting" of the UHF business band (450-470 MHz) many units are becoming available. Of these the Motorola T44AAV (mobile) and L44AAB (base) units are the most common. Since the transmitter and receiver strips are identical in each unit, either may be used as the basis for control links. A scheme for using these units is outlined later in this article.

When radio links are used it is necessary to use some type of information to operate or disable the repeater. Although some repeater groups are now using digital techniques, the easiest method is tone control. Simple tone oscillators such as used in AFSK systems may be used with RTTY type tone decoders at the repeater site. These decoders may be used to operate a stepping relay to shut the repeater down, then back on, etc.

The squelch relay is needed to operate the transmitter when a signal is received by the input receiver. Such a circuit reproduced as Fig. 2. A detailed description of the operation of this circuit may be found on page 92 of the *FM Schematic Digest* published by Two Way Radio Engineers Inc., a *73* advertiser.

A timer is also required by the FCC. This insures that the repeater transmitter will not transmit for a period exceeding three minutes. This prevents tying up the frequency if someone inadvertantly keeps a transmitter operating continuously on the input frequency or if there is failure in any portion

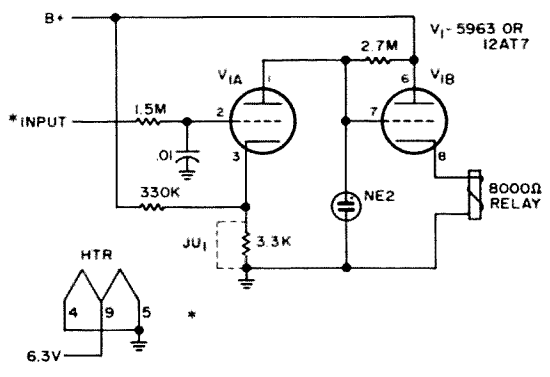


Fig. 2. Schematic of Motorola TK297 squelch relay (COR).

7. *Radio Amateurs VHF Manual*, Eleventh Edition, pp 298–299.

8. *Radio Amateurs VHF Manual*, Eleventh Edition, pp 299–302, or Jessop, G.R., *VHF-UHF Manual* (RSGB), pp 4.1–4.3.

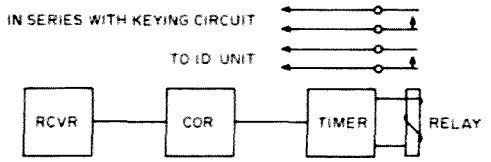


Fig. 3. Timer logic.

of the repeater system. Such a timer may be of either the electronic or electro-mechanical type. The electro-mechanical type is cheaper in most cases. The timer is actuated by the squelch relay whenever a signal is received. If the received signal stops before the time limit is up, the timer resets and begins operation anew when another signal is received. When the signal is in excess of the allotted time, the timer shuts down the repeater transmitter. When the signal stops, the timer resets, and the repeater transmitter may again operate. A working hookup for the timer appears as Fig. 3.

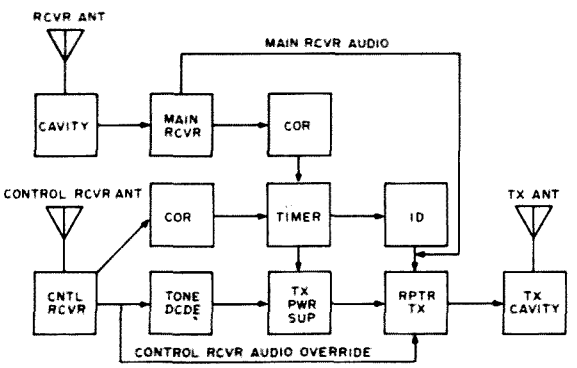


Fig. 4. On-site repeater operation.

Each repeater licensed by the FCC also must have its own call sign. This call sign must be transmitted in accordance with FCC regulations. Two methods are suitable for repeater ID: Voice ID and MCW ID. The voice ID may be accomplished by using a closed loop on a tape recorder playback head. The actual words used can vary, but many repeaters have the call sign and location. The MCW method can use either an electromechanical arrangemen such as a code wheel or an electronic method[9]. In either case the ID is usually as follows: "QRA DE WA5XXX."

9. Connors, John, "A Programmable Repeater Identifier," *Ham Radio*, April 1969, pp 18–23.

The repeater System

The repeater system components and their relationship to each other are described in Figs. 4 and 5. Fig. 4 is the on-site repeater diagram and Fig. 5 is the split-site repeater diagram.

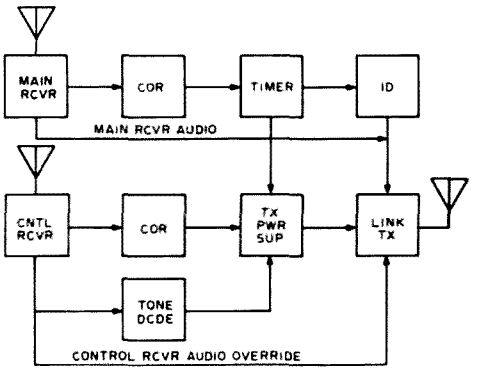


Fig. 5A. Split-site receiver.

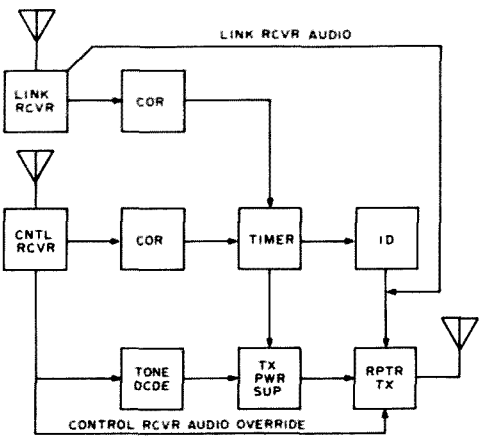


Fig. 5B. Split-site transmitter.

Control Stations

The block diagram of a control station appears as Fig. 6. This station (or a number of these stations) must be manned 24 hours per day if the repeater is in constant readiness. If the control station is not manned for any length of time, FCC rules

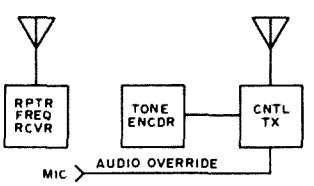


Fig. 6. Control station.

require that the repeater be made inoperative until the control station is remanned. Such a control station should consist of a transmitter capable of operating on the control link frequency, a tone encoder for operation of the control circuitry, a directional antenna[10] (also required by law), and a receiver capable of receiving the repeater transmitter. The logic at the repeater site should be wired to allow the control transmitter to override any incoming signal (see Fig. 7).

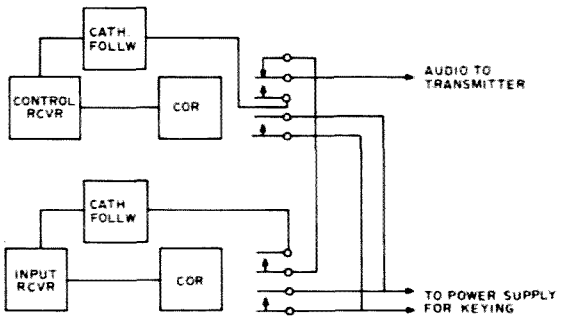


Fig. 7. Relay logic for audio override.

Logging Station

The FCC also requires that accurate logs of the repeater operation be kept. A simple method of achieving this is to use a receiver on the repeater transmitter output frequency with a COR operating a tape recorder. If a dual channel recorder and a second receiver tuned to WWV or CHU are used, a time hack will appear along with the information transmitted through the repeater. The tape can be changed and retained for one year and then reused. A block diagram of this appears as Fig. 8.

Antennas

The antennas used in the repeater system should be omnidirectional. Everyone has his own ideas as to what type is best, so I will not try to recommend any one particular type. If the on-site system is used, keep the receiving antenna as far away from the transmitting antenna as possible. This will reduce the receiver desensing by the transmitter. The radio link and control link antenna(s) should be directional. Small beams[11] or modified UHF TV corner reflector make excellent link antennas (especially when fed with low-loss foam twin lead).

Audio Coupling

Commercial FM repeater systmes often use a wire line termination chassis for coupling the audio from the input receiver to the output transmitter. This system is fine if the chassis is available. Since this is not usually the case, a simpler and less expensive method must be used. The simplest and most effective method is to connect a cathode follower circuit to the audio output of the discriminator. The output of the cathode follower is then fed into the microphone input of the repeater transmitter (or link transmitter in the case of split-site repeaters). This system allows the deviation of the output transmitter to be independently controlled by the deviation control in the transmitter, and not by the audio gain control in the receiver. This way the audio section of the receiver may be used for monitoring whenever a maintenance team is at the repeater site. If the audio is taken from the receiver audio output stages and then coupled to the transmitter, any resetting of the audio gain control will require recalibration of the transmitter deviation. Usually the audio required for sufficient deviation results in a very low audio output from the receiver. Thus, when a service team turns up the audio to hear incoming signals, the deviation from the transmitter increases. Thus, it is desirable to isolate the audio going into the transmitter from the audio going to the speaker. This is why the cathode follower circuit. See Fig. 9 for a working unit.

Audio Override Circuitry

It is very desirable to allow the control station audio override. This enables the

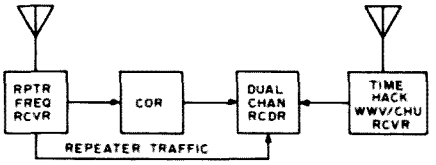


Fig. 8. Block diagram.

10. Zook, G.E., "Curtain Rods, Coat Hangers, and Control Links," 73, June 1969.
11. Ibid

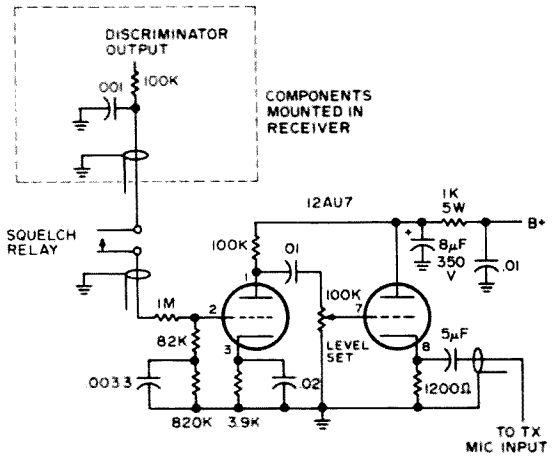


Fig. 9. Cathode follower.

control station to break in over any station on the regular input frequency. This may be accomplished with simple relay logic which appears as Fig. 7.

Tone Control Units

A tone control unit for turning the repeater off and on is a legal necessity. The basic circuit can be the same as a RTTY tuning unit. The only difference is that the tone is continuous rather than shifting. To avoid unauthorized control, the control tone may consist actually of two tones. The only requirement is that they not be harmonics of each other or have a beat note that is a harmonic or sub harmonic of either tone. The relay logic may then be worked so that both tones must be present for the control system to work. A diagram of the logic appears as Fig. 10.

Single Tone Units for Restricted (or Closed) Systems

Single tone units for closed systems are only slightly harder to build than normal audio circuits. The requirements are that the tone be short and on the correct frequency. The schematic of the tube type Motorola encoder (transmitter unit) and decoder (r-eceiver unit) appear as Fig. 11 and 12. These circuits may be easily duplicated and the

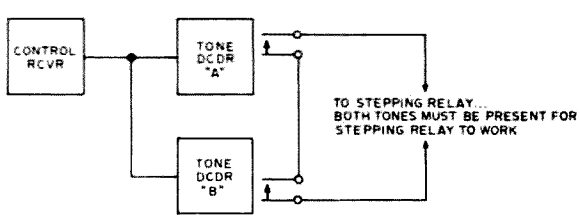


Fig. 10. Relay logic for two tone control.

Single Tone Units for Restricted (or Closed) Systems

Single tone units for closed systems are only slightly harder to build than normal audio circuits. The requirements are that the tone be short and on the correct frequency. The schematic of the tube type Motorola encoder (transmitter unit) and decoder (receiver unit) appear as Fig. 11 and 12. These circuits may be easily duplicated and the tone frequencies varied to fit local requirements.

Deviation

Although amateur FM activity has been generally of the wideband (±15 kHz) variety the trend is toward narrowband (±5 kHz). This is because of two things: The equipment now being released is of the narrowband variety and the population on the VHF bands is increasing by leaps and bounds thus requiring more and more channels. Wideband receivers will receive narrowband signals with a loss in audio gain. This may be overcome by the addition of audio recovery circuitry. Such circuitry usually consists of only two or three resistors. The other narrowbanding circuitry consists of sharper high and low i-f stages. These are not normally required in amateur operation. When a narrowband receiver is used in a

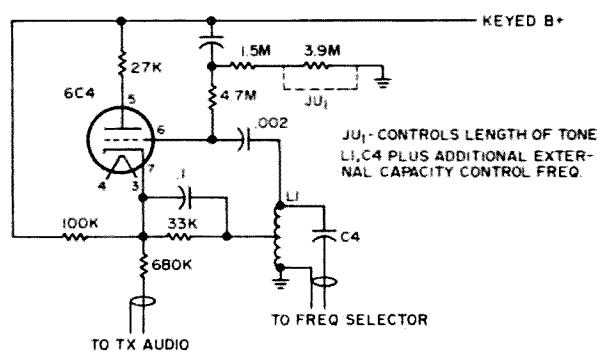


Fig. 11. Motorola single tone encoder.

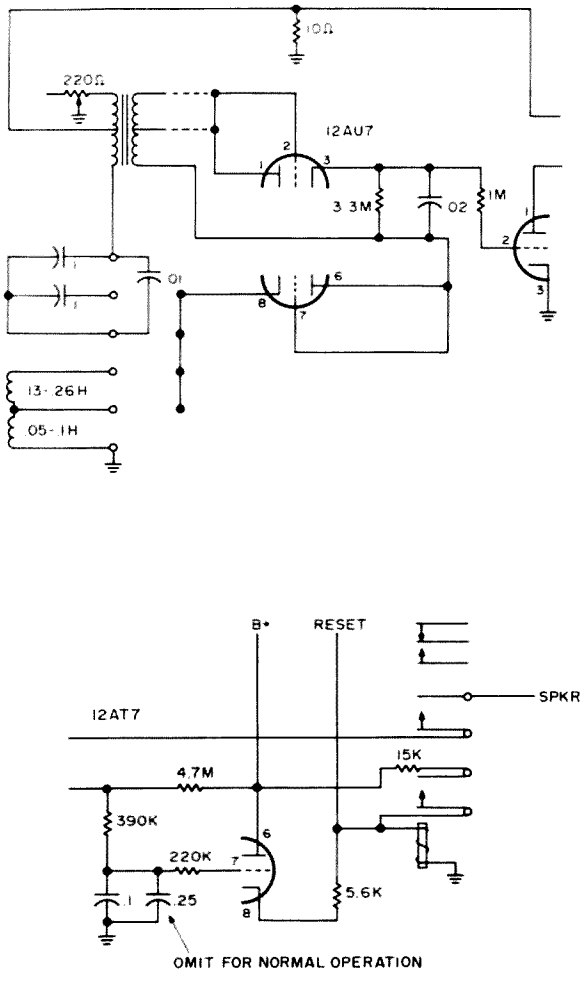


Fig. 12. Motorola single tone decoder. See p.f 91–92 in FM Schematics Digest for frequency and operation information.

wideband system, the signals will "chop out" unless the squelch is turned off. If the units in a particular area are divided between narrow and wideband units it is possible to use ±7.5 kHz deviation. This is sometimes called "belly-band." Such deviation will not chop out on narrowband receivers and will produce sufficient audio on wideband receivers.

The repeater system should be adjusted so that whatever deviation comes into the system goes out at the same level up to the point at which the transmitter clipping circuit takes over. This requires a little patience in adjustment, but it is necessary especially when the units using the repeater also work direct on other frequencies.

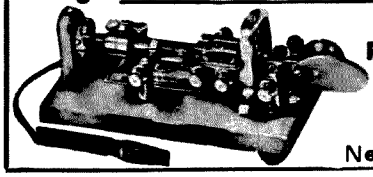
Location

The location(s) for the repeater must be carefully chosen. Just because a location is

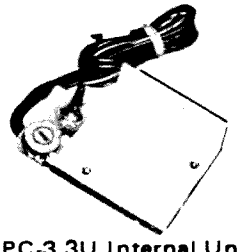
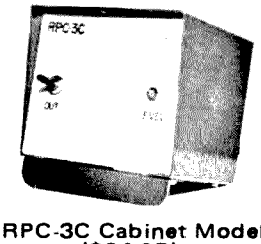
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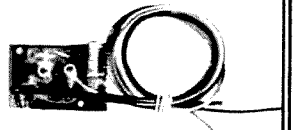
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high it may not be the most desired. Often high buildings are built in lower areas. Radio and television transmitting towers are often built on the highest points around but may be located some distance from the desired coverage of the repeater. Also, the noise level at some sites may be much higher than at others. Close proximity of heavy traffic may affect six meter receivers but have much less effect on two meter equipmen. Other transmitters in the business or public safety services may cause intermod which may be greater at one location than at others. Thus, it becomes necessary to check the site out before the repeater is installed. This checkout should be made in several trips to the site at different times of the day and on different days of the week. The noise level on Sunday afternoon will probably be much lower than on a Monday afternoon when everything is in full swing. At night, neon signs and similar electrostatic systems may produce interference which adds to the total noise figure.

The desired location should have the following characteristics: high in relation to the area to be covered; centrally located within the desired area; convenient for access to the equipment for service; have an enclosed weatherproof place for the equipment; have sufficient power capabilities; low or no charge for use. Of course not all criteria can be met in all cases. It may be necessary to sacrifice an enclosed mounting area for a lower noise level. Or, in the case of a centrally located TV transmitting tower ease in access may be sacrificed for the height gained. In all cases a little common sense will save many headaches. For instance, don't put a six meter repeater on a channel two tower! The lower sideband of the TV signal though attenuated will completely block the six meter receiver.

If a location is found that meets all criteria except permission for use, it is often only necessary to approach the local Civil Defense or Red Cross office. Often these organizations will lend their influence to obtain permission to use a site (often at no charge, even for electricity!).

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Model 407 price: 5–200 MHz $42.95
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Prices include .005% crystal. Additional crystals $5.95 ea.

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11 CHANNELS • 135–250 MHz



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Model FMR-250-11 price: 135-180 MHz $109.95
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repeater. Each system requires something that another system may not. However, I will outline two systems (one for six and one for two meters) which I prefer. These systems use Motorola equipment exclusively. This is not to say that equipment manufactured by other companies is not entirely satisfactory. The reason that I have selected Motorola is familiarity, based on having worked with the equipment during employment with Motorola Communications & Electronics,that portion of Motorola which manufactures and sells the FM equipment. In fact the repeaters in the Dallas-Fort Worth, Texas, area utilize from a complete Motorola system to a hybrid of General Electric and Motorola with a little RCA thrown in for good measure. Each one of these repeaters operates very well.

My choice for a six meter repeater is as follows: A split-site with input and output frequencies separated by 100 kHz. The receiver site would utilize a "J-Pole" antenna feeding a Motorola "G" receiver. The audio output would be fed from the discriminator through a cathode follower to a 18 watt output (cut back to 10 watts) 450 MHz Motorola "A" transmitter operating on or about 449 MHz. This link transmitter would feed a small yagi antenna aimed towards the transmitter site. The squelch relay would be of the tube type described earlier. The timer would be electro-mechanical for good reliability. The control receiver would be a Motorola "A" 450 MHz receiver operating around 445 MHz feeding a two tone decoder. The tone decoder would operate the latching relay to enable the receiver link transmitter to be turned off and on by the control station. The control station would have audio override capabilities. The transmitter site would utilize a Motorola "K" or "J" transmitter (60W and 100W output respectively) cut back to around 50 watts. The receiver from the link would be a Motorola 450 MHz "A." The audio would be fed from the discriminator through a cathode follower to the transmitter. The squelch relay would be the same tube type as mentioned before. Proper identification with the repeater call sign would be accomplished by a code wheel keyed by the timer. The timer would again be electromechanical. The control receiver would be another Motorola 450 MHz "A" operating on a frequency 100 kHz above the control receiver at the receiver site (this is to allow a single control station with a two frequency transmitter to control both sites). The tones utilized would be different to avoid possible accidents. The tone decoder would be the same design as at the receiver site. The transmitting antenna would be another "J-pole."

The control station and logging station would be at the same location. The control station would consist of equipment capable of operating on the repeater input and output frequencies such as a Motorola L41GGB. The 445 MHz control transmitter would be either a 450 MHz "A" or, if obtainable an L44BBB consolette base station. The encoder would consist of four oscillators using telephone type toroids as the frequency determining circuit. The control link antenna would be a small yagi.

The logging station would consist of a receiver operating on the repeater output frequency feeding a stereo tape recorder recording at the lowest speed possible. The tape recorder is turned off and on by a squelch relay. The audio would be taken from the receiver through a cathode follower and fed into one channel. A command receiver would be tuned to either CHU or WWV (whichever gave the best 24 hour signal in the area) and its output fed through a cathode follower to the second channel.

My two meter repeater would be of the on-site variety. The antennas for both transmitting and receiving would be of the fiberglass "croppie pole" variety. The receiver would be a high band Motorola Sensicon "A" (this receiver has a front-end which incorporates either five or six cavities depending on the exact model). If needed, a cavity would be placed in the receiver antenna line. The transmitter would be either a Motorola "A" or "K" (both 60 watt output rating, differing only in that the "A" utilizes an 829B final whereas the "K" uses a 5894) cut back to 50 watts output. A cavity would be put in the transmitter antenna lead. The timer and audio circuitry would be the same as in the six meter units, as would be the control link. In all cases the power

supplies would be Motorola P8464 units. Also, both repeaters would be open to all amateurs.

As stated previously, units manufactured by companies other than Motorola will do an excellent job. The General Electric Progress Line units are used quite extensively as are RCA 450 MHz units. The prime concern is whether or not the units used meet the requirements of the particular system. In some systems very low power in the order of only two or three watts will do the job. In other systems a "quarter KW" (250 watt output) transmitter may be needed

Why the Repeater?

This article has progressed under the assumption that the decision to establish an amateur FM repeater has already been made. For the benefit of any hardy soul who has read this far and who has not made up his mind or who requires a little more knowledge as to repeater operation I have listed below some of the pros and cons of repeater operation.

An amateur FM repeater serves to greatly increase the usefulness of mobile units by increasing their effective range. A low power mobile signal is received by the repeater at a distant, but favorable spot and then retransmitted at a higher power level from a transmitter also located at a more favorable spot. The same can be said for portable and hand-held equipment. Using repeaters it is often possible for two one watt hand-held units to talk over ranges (including to each other) which high power base stations may have trouble communicating. The range of base stations is increased, especially when talking to mobile units which may be in poor locations regarding the base station. During band openings (and these DO occur) the repeater will hear and be heard by distant stations long before most base stations can be heard. For example during the Spring of 1969 the Tyler (Texas) repeater and the Tulsa (Okla) repeaters were hearing and being heard by FM amateurs over a great portion of the Eastern USA. The St. Louis repeater was heard in the Dallas – Fort Worth area, thus allowing two meter FM operators to work each other over large portions of the country.

Along with the good of amateur FM repeaters there also must be the bad. Some amateurs tend to use the repeater as a crutch. That is, they keep their equipment and antenna systems working only well enough to use the repeater. When the repeater is off for repairs or when operation on another frequency is desired, these stations are marginal if operative at all. Also, if a new location is tried for the repeater, amateurs who formerly were near the repeater and who have not maintained their equipment will suddenly become very unhappy because they cannot use the repeater without working on their equipment. Another problem is that two stations using the repeater can tie up the frequency for others within the range of the repeater. This can be solved by several methods, including use of alternate frequencies once contact has been established and of allowing short pauses for other stations to break in. Some repeater organizations limit the time which the repeater may be used for a single QSO. This, however, is distasteful to many amateurs. Thus, a little courtesy will do wonders for the usefulness of the repeater system. A third possible problem occurs when ac power is lost during an emergency situation. Since the repeater is very useful during emergencies, it should be provided with an auxillary power source independent of the usual ac lines (such as an automatic starting generator). Also, many mobile and portable units have only repeater frequency capabilities. This should be overcome by the incorporation of direct transmitting capabilities as well as repeater input.

Conclusion

All circuits included in this article are presently in use in either amateur or commercial FM repeaters. Since each repeater will have a slightly different requirement from any other an exact model is not practical. However, by using the circuits in this article along with the equipment locally available it should be possible to build an effective repeater for local amateur FM activity.

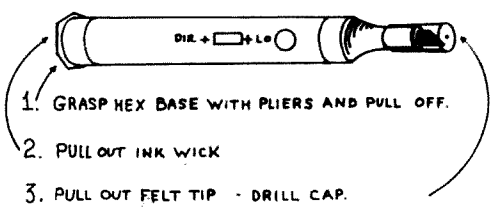
. . .K9STH

Walter W. Pinner WB4MYL
7304 Lorenzo Lane
Louisville KY 40228

TEST PROBES need not be costly!

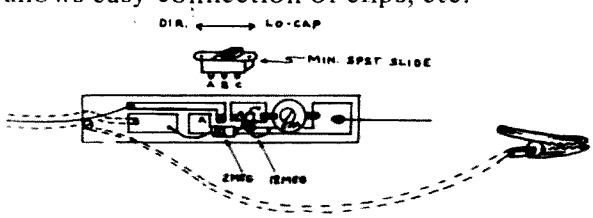
The proper test probe for your vtvm, FET, vom, or scope won't cost the usual $12–$19 if you are willing to spend an hour, a few cents, and follow the procedure below.

The usual stumbling block in home brew probes is not the circuitry but obtaining a suitable housing or probe body. The common *"Carters Marks-A-Lot"* felt tip pen appears to be the answer. These felt tip pens have an aluminum housing which is convenient to hold, is large enough to house the necessary components and, when the paper label is removed, has a professional appearance when assembled. Obtain an old pen (new will also work, if you must), and disassemble as shown in Fig. 1. Any of the



probes listed below may be assembled as the example in Fig. 2 (low capacity scope probe). The direct, low capacity switch – spst – may be incorporated or eliminated from any of the circuits shown.

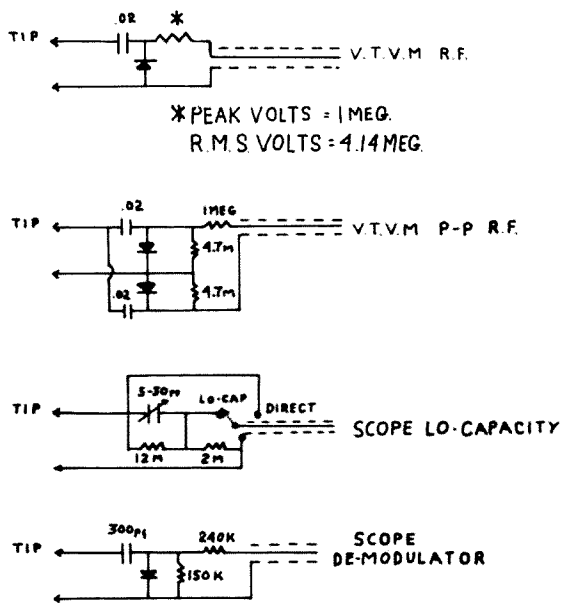
Component mounting may be on a small single side etched board, or copper clad is easily cut with a hobby knife where straight line patterns are required. Vectorboard or thin plastic material may also be used. If plastic is used merely heat a small piece of wire and melt the component mounting holes where needed. The probe tip may be a piece of stiff tinned wire or a pin type connector. The use of the pin connector allows easy connection of clips, etc.



Caution: These felt pens are available with both metal and plastic caps. Should your pen have the metal cap it should be discarded. The tip may be isolated from the body by slipping a small piece of the inner insulation from a piece of RG58 type cable over the tip and sliding it down into the probe body. The ground lead is a 6 to 8 in. piece of shield from RG58 cable. Be certain the ground lead is secured to the probe housing as well as the circuitry and solder a clip to the free end.

The circuits shown below are designed for vtvm or vom with an 11 MΩ/V impedance. The scope probes are designed for scopes with 1 MΩ input.

In the following circuits, the dc blocking capacitors are 600V rated. The 1N55 diode has a piv rating of 150V and will safely handle 50V of rf. Once the assembled circuit



with connecting cable has been inserted into the probe body, push a small plastic cap, which has been drilled, over the cable, and on to the open end of the probe. Be sure the cable shield is grounded to the circuit ground as well as the probe body. A small amount of R.T.V. (rubber seal) inside the plastic cap will act as a strain relief.

. . .WB4MYL

Lee Coltin K6VBT
5830 Delray Street
Clendora CA

Simple Base Supply For 6E Pre Prog or Prog Line From Junkbox Parts

Finding parts for an ac supply can be easy if you have in mind the "how to do it."

Here is a simple and quick way to lash together a supply that I found in the old junkbox.

T1 can be any heavy duty transformer (an old TV transformer is ideal as it usually has a high filament rating).

I built mine on a 19 x 5 in. rack panel, but a chassis box works well and can be installed in the mobile case.

Don't forget the caps across the relay contacts as they are very important. Their function is to prevent arcing of the relay contacts.

. . .K6VBT

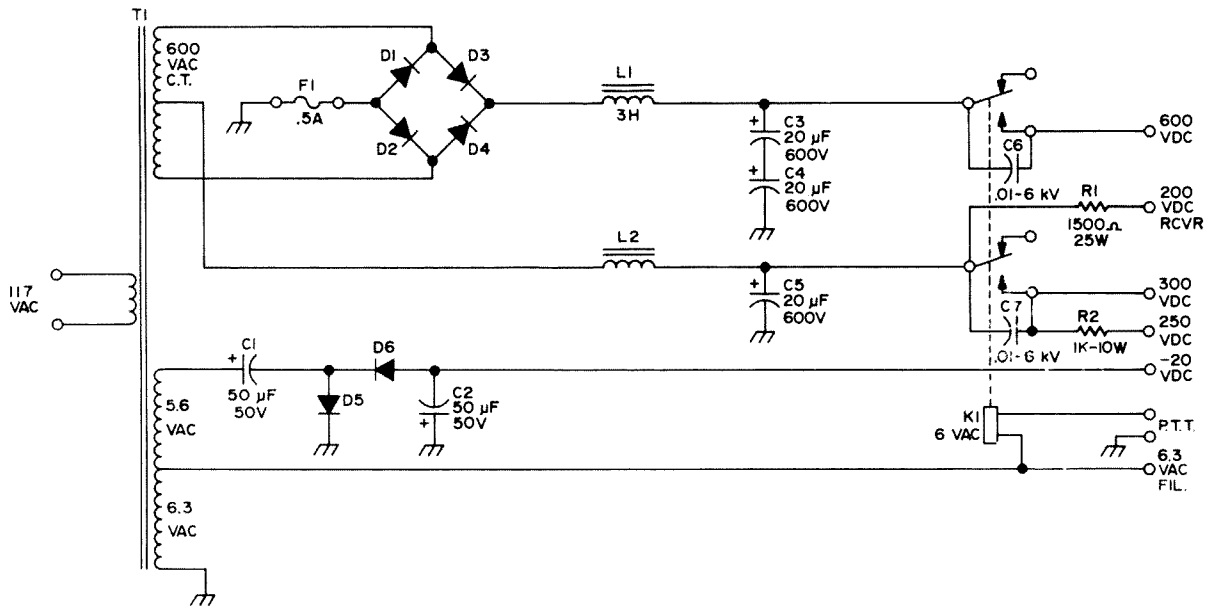


Fig. 1. Base supply. T1 – Merit P3059 or equivalent; Sec. #1 – 550–600V CT; Sec. #2 – 6.3V ac @ 3–5A; Sec. #3 – 5.6V ac @ 2–3A; D1-4 – 1000V diodes @ 1A; RL1 – DPDT relay 6.3V ac coil.

Zero-Beating with the Frequency Meter

After putting an LM-18 in service, I found it a nuisance to plug in headphones every time it was necessary to adjust the corrector control to produce Zero Beat at one of the crystal check points. I hooked up a phone plug to the plate winding of an audio output transformer, and then connected a small loudspeaker to the secondary winding. I leave the phone plug inserted in the LM phone jack at all times. After using this setup for a while, it occurred to me that the last few cycles either side of zero beat might not be audible, so I tried a parallel hook-up off the primary side of the transformer. The other end of the cable was connected to the Vertical input of an oscilloscope. Now, when adjusting the corrector control for zero beat, you will see low amplitude sine waves even after you can no longer hear the beat note. You tune out the sine waves until you have a perfectly straight reference line on the scope. The Heterodyne oscillator is then corrected to calibration much more accurately than trusting to the ear alone. The principle is not new, yet the idea may not have occurred to some people. Any old scope will do, as the frequencies are in the audio range.

Another bit of frustration occurred when trying to adjust the corrector knob. I would pass the zero beat point time and time again, due to the stiffness of the control. Remember, these units are built for ship-board use, and loose controls cannot be tolerated. I dug up a small vernier tuning drive, similar to the Jackson Planetary-Vernier drive, (about 5 to 1 ratio). I mounted this drive on a right-angle aluminum bracket and attached it to the LM using the two screws on the upper right side of the unit. Bore holes slightly oversize to allow for accurate alignment of the control shaft so that it will not bind. Cut out a portion of the bracket so the "High-Low" knob can be moved. The precise Zero beat adjustment can now be made very easily with the reduction drive.

Jim Harrison, Jr., WB4TBX



"Fred's brother is on vacation somewhere in South America. We thought maybe you could give him a call . . . "

Ronald M. Vaceluke W9SEK
17 W. 540 Hillcrest
Wood Dale IL 60191

RANDOM ACCESS PUSH BUTTON SWITCHING

There are many applications in which random selection switching is better than the sequential action obtained by using a rotary switch. For example, in television it is advantageous to be able to change quickly from one camera to another without having to go through a fixed pattern of selection. The interlocking push-button switches on the market today fill the needs of many applications; however, they do have a number of disadvantages. If one section of the switch goes bad, usually the whole assembly must be replaced, which is both time consuming and expensive. In some applications it is necessary to provide the same switching functions from more than one location, which means that some sort of a release device must be provided at unused positions. This is usually a solenoid that operates the release mechanism on the button assembly. This involves expense and space that might be better used elsewhere. What would seem to be most desirable is a system that would use relays to provide switching of the controlled circuitry, and would use individual push-buttons (illuminated or non-illuminated) of the single pole type to control the relays.

With this in mind, a circuit was developed which allows the following:

1. Use of any normally open momentary action switch.
2. Use of low voltage dc relays.
3. Use of as many circuits as are necessary, operated from one or more locations.
4. Easy expansion of the system.

The circuit is actually a variation of the self-holding type (Fig. 1) which is probably familiar to many. Once the "on" push-button is activated, the relay operates and its own "make" contacts then mantain the path first established. In order to release the relay, a normally closed switch must be momentarily operated, which breaks the path to the relay coil and allows it to return to its unenergized condition.

In the revised circuit (Fig. 2) the operate button (OP. . .) is momentarily depressed and the first relay to operate is RL. This is

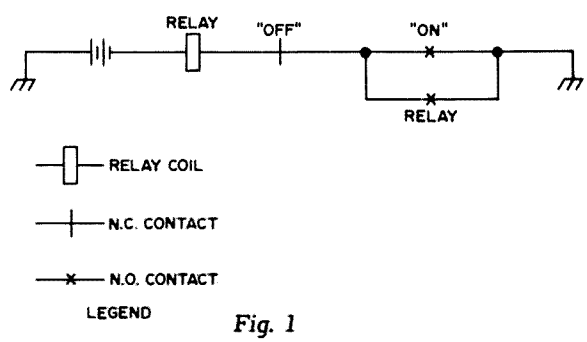
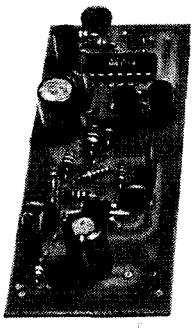


Fig. 1

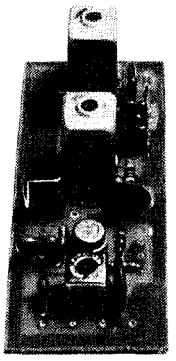
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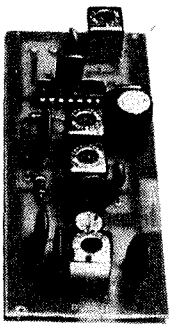
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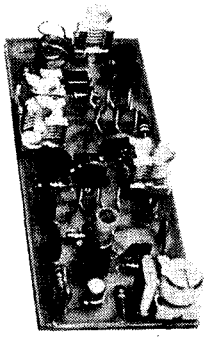
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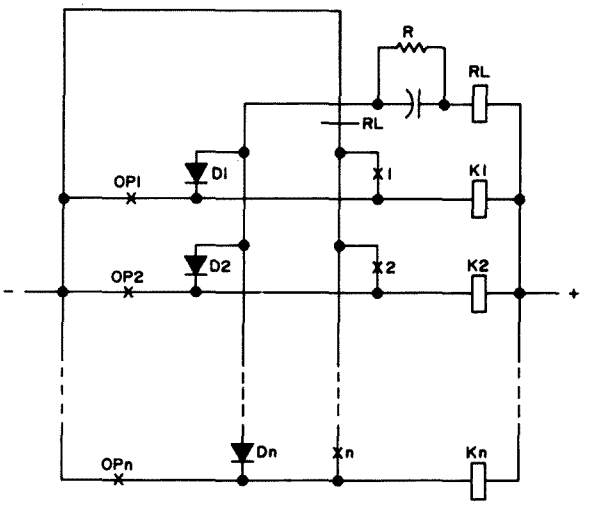
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VHF ENGINEERING

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the release relay, which comes up briefly until the capacitor C is charged; and current flow through RL ceases, allowing RL to return to its normal (released) condition. Resistor R across C provides a discharge path for the capacitor and should be small enough to let C discharge rapidly, but not so low as to hold RL operated. It can be seen that a normally closed contact on RL is in the hold path for all the other relays in the circuit. When RL operates, it opens the holding path for any other relay in the circuit, allowing it to release. This also stops the possibility of the newly selected K . . . relay from latching until RL releases. By choosing the operate and release times of RL and the K relays, make-before-break and break-before-make operation can be achieved.

The C capacitor must be empirically chosen for the particular relay used for RL. This relay must operate and release quickly, allowing only sufficient time for any operated K relay to release. Proper operation of this circuit is a matter of timing. Relay RL operates and releases as well as a K relay operating all in the short time interval that



the OP . . . switch was held operated. If illuminated push-button switches are used for OP . . . , the lamps for these can be connected across its associated K . . . relay. These lamps and OP . . . switches can be wired in parallel so that operation can be effected from more than one possible location.

. . .W9SEK

Bill Hoisington K1CLL
Far Over Farm
Peterborough NH 03458

AN ANTENNA and DIODE RECEIVER for 432 MHz

This discussion concentrates on one example of an antenna and one example of a diode receiver for 432 MHz. These units should serve to take you well up into the fascinating field of low-cost solid state microwaves which is just beginning to open up.

In transistors we now have the $1.50 plastics which operate on 1296 MHz, stemming as usual from the mass market of radio and TV, and who knows, if TV gets into microwaves perhaps we'll get microwave transistors for a buck.

Actually the process is already beginning, with the auto radio industry leading off with radar brakes, highway guidance and the like, up around X band. Detroit is talking (as usual) not in hundreds of systems but millions of systems. This may well bring us the X-band diode oscillators for under $10. They already can be bought for less than $20.

Interested? Let's plunge into the deal. You only have to add another oscillator and a broadband i-f strip to turn the diode receiver into mixer and make up a superhet receiver. For only $6 you can modulate the transmitter and who knows how far you can

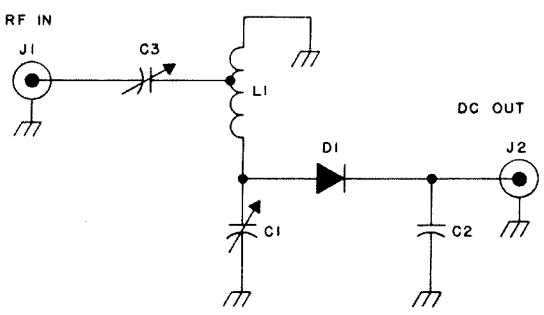


Fig. 1A. Schematic of diode receiver for 432 MHz.

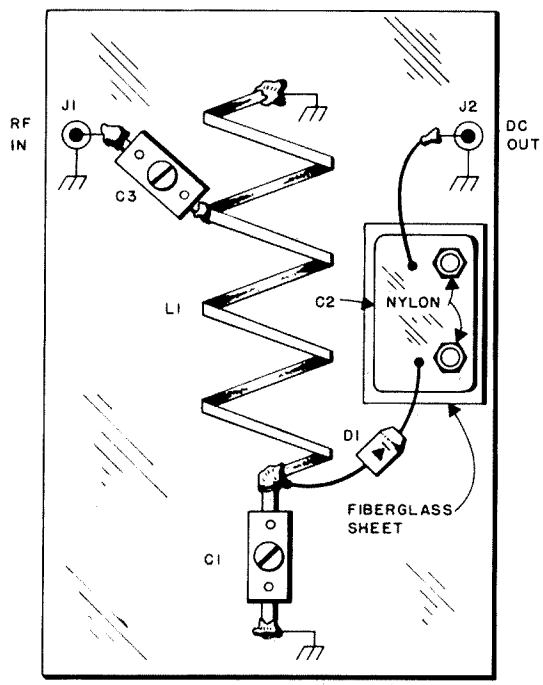


Fig. 1B. Lifesize drawing of the 432 MHz diode receiver layout.

QSO from mountain tops. The whole rig needs only a 98¢ lantern battery for power. *Use* your license and have more fun! I guarantee you no QRM, except perhaps when the band opens up.

Diode Receiver for 432 MHz

In order to check out the antennas you will have to have a receiver, and the design shown in Fig. 1 is just about as simplified as you can get and still tune well and be very sensitive. It works!

Using a parametric microwave diode it puts out 5V dc on J2 from a 432 MHz oscillator coupled to it with some 5 ft of RG-58 cable. This is using inexpensive RCA-type phono jacks for rf connectors by the way.

C1 peaked up immediately as soon as the oscillator was turned on. This type of receiver works well right up to 2500 MHz, although you should use a half wave line instead of a quarter wave at that frequency.

It seems almost funny to use a coil and shunt capacitor for tuning at 432 MHz, but ever since I tried it I find that it's hard to beat and certainly is handy.

You might say no precautions are needed for this one, and you'd be nearly right. C2 is a brass capacitor to ground, about 1 in. square. C1 and C3 are ceramic trimmers, or mica compression trimmers, about 1–8 pF.

Every little four or five turn coil I've wound so far has worked on this band. Start the rf input tap of L1 at one turn from ground, and maximize later. I'll admit the diode is a super-duper. It's a Schottky-barrier type, made by Parametric Industries of Winchester, Mass., costs nearly $3 and is worth every penny of it. It's good up to X-band, and is a good mixer also as soon as you want to convert this diode job into a superhet.

Standard Test Antenna for 432 MHz

This can also be quite a subject by itself so we'll just hit the essentials and show one good example of a working model.

On these frequencies you have the antenna right on your bench where you can put your fingers on it, tune it, add or subtract

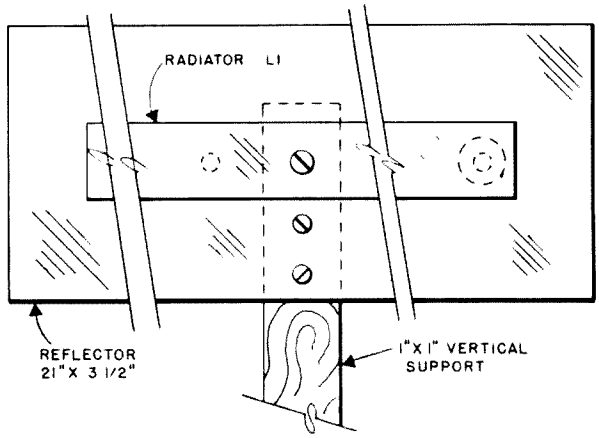


Fig. 2A. Front view of the test antenna 432 MHz.

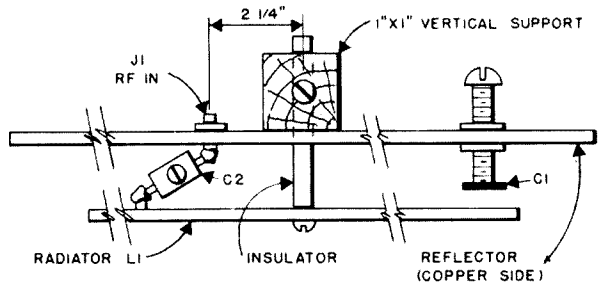


Fig. 2B. Top view of the test antenna for 432 MHz.

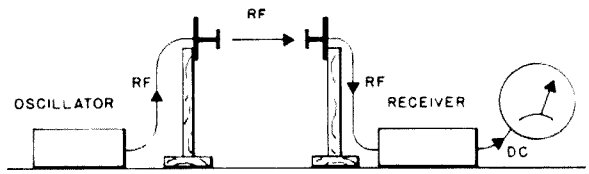


Fig. 2C. 432 MHz test setup and antenna tuneup.

lengths, change spacings, check for high and low rf voltage to be sure you do have a half wave, find the 50Ω points (there are two of them), vary the Q, change the directivity, measure the frequency of your oscillators, and find the antenna gain. All this without either a power meter or a frequency meter. I just don't happen to have either of those myself.

Lads working for large companies get their pictures taken checking little pieces of equipment surrounded by masses of expensive-looking test sets, meters, and scopes, mostly bought by Uncle Sam.

We're not making omnidirectional antennas, so let's start with a reflector of copper clad, large enough so it doesn't resonate, put

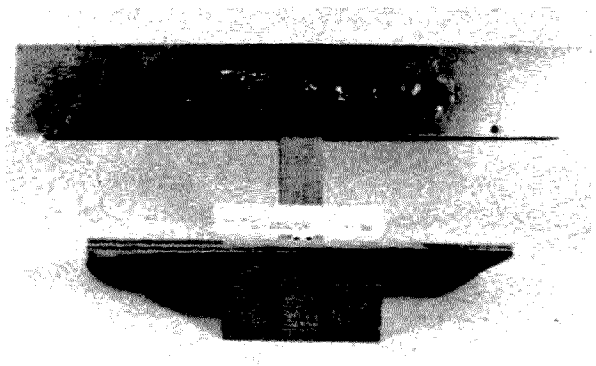


Photo of test antenna. Six inch ruler shows scale.

There is of course the physical need of moving C2 when you change the spacing of the radiator L1. I sometimes use a mica trimmer with a slightly S-shaped soft copper strap in order to be able to vary the spacing of L1 without changing C2. When an approximation is reached, and you get the feel of it, you can put in a permanent connection.

The value of C2 of course depends on the other parameters also. This is quite the usual order of things in R&D, where a number of variables have to be shifted around. For the experimenter the best way is by a series of a half wave radiator out in front, and see what happens. Make it a little short so you can tune it, and mount it at the center on an insulated push rod so as not to affect the voltage distribution, and install C1, a "penny tuner" near one end, as in Figs. 2A and 2B.

Bring your 50Ω rf input cable into the picture through the reflector on J1. This is an experimental antenna so you could make several holes for J1 in order to find the best match along the radiator. Either side starting from the radiator center will do.

C2 cancels the inductive reactance that starts building up the moment you uncover the center conductor of your feed cable to connect it to something. If you look carefully at this antenna and imagine it to be 270 ft long and suspended high over the field near your shack, you will see a certain resemblance to a Windham antenna. Just a resemblance, mainly in the one wire feed. When I have passed on to that Happy DX Mountain in the Sky, maybe this one will be called "The Old Hoisington Antenna."

The radiator is now ready to go to work for you. Bring the 432 MHz energy in on K1, put another standard antenna a few feet out in front and facing it, attached to the diode receiver, and watch that meter.

Tuning

For the radiator length you can start with some 10% less than a half wave in space which should give you nice tuning on C1. Generally you should use as small a capacity as possible for C1, just enough to peak the radiator. Be sure it *does* peak, that is, go through resonance with a maximum which then falls off on each side. Watch your receiver meter to see that this does occur.

Spacing

This is a trade-off like so many things in life, as well as in science. At ¼ wavelength spacing you will get the lowest Q, with very broad tuning. At very close spacings you can get a high enough Q to make an oscillator or an amplifier out of the radiator, but that's another whole story.

It won't take you long to find the spacing you need with the system test setup of Fig. 2C.

Finding the position of C2 along the radiator, L1 is next. When you start to work with this parameter you will see its interaction with some of the others such as its value in pF, which will be low, radiator length, spacing, C1 tuning, width of the radiator, and possibly more.

Table I. Antenna Test, 432 MHz

Reflector Size	Radiator Length	C2 in pF	Distance C2 to Center of L1	D, Radiator spacing from reflector D, Spacing Radiator to Reflector	Remarks, Tuning of C1. Also the Bandwidth
21" long, 3½ wide	11¼	Open.	2 1/8	7/8	Sharp
		Less than 2			
		2 to 3 pF		1½	Medium
		7 to 8 pF		2"	Broad

approximations. You set up one item, vary the others, set another value in, change some more, and after some time goes by, and if you're lucky, you begin to see the best range of values for each parameter. You're getting close then. Pretty soon, if your luck holds, although it may take hours or days, as with my 36 ft wide-spaced two meter yagi where it took weeks, you will reach the point where anything you do *drops* the gain of the antenna you are tuning up. Then you're real close. In fact you could very well stop there and check the gain relative to a dipole by the distance method, and you should then have a good test antenna.

Just to show you what you can learn about a radiator and sheet reflector in a short time, here is one test run that was performed on the antenna of Fig. 2A. The equipment test setup is shown in Fig. 2C. Two antennas as in Fig. 2A were used, and the changes made on one of them. Table I shows the result. A lot can be learned from just that one run using three settings for the spacing of the radiator from the sheet reflector.

1. With close spacing it doesn't take many pF to couple to the radiator. The radiator is "hot" and sharp in tuning and a small amount of coupling pF will cause a large reaction (energy feed).
2. As you go toward the ¼ wave spacing, the Q drops, and the radiation increases. Witness the increase in power at the receiver.
3. As you go *past* the maximum radiation point the Q is going down and the radiation drops also due to less rf on the antenna, and the antenna is also more broadband. This latter may be desirable from the point of view of the vfo lad chasing all over the band (this does not necessarily apply to the 432 band as yet!) but he just won't have the gain of the chap who peaks up and stays near that frequency.

Notice that several other parameters were not varied in this test run. After all, I said it was a short run.

If this gives you some ideas to try yourself, that's why I wrote it.

. . .K1CLL

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W2NSD *(continued from page 2)*

er? The Standard 146 comes with 34–94 permanently wired into place. So why make this a useless combination in all of the major cities?

Is it possible for repeater groups in each major city to get together and put up a 34–94 machine which will enable visitors using one watt units to have some fun and meet local amateurs? It needn't be a gigantic alligator, just something so that when someone comes to New York he will be able to talk a little. No other channel has the possibility of being, quite simply, a universal calling channel and meeting place for travelers.

If there is any mass movement to 52 for a simplex channel you can bet that crystal prices will drop even lower than they are at present. A 52 pair now costs about $7.50. If the crystal manufacturers are able to turn out thousands of them at a time the price could drop to about half of that. It's up to you.

Should 34–94 become a national calling pair, it is possible that an autocall system could develop. That would be nice too. As it is, in the larger cities, you have to check into a dozen or so repeaters when you are looking for one particular fellow since he might be using any repeater. Or none. So use the phone, right?

Down Links

Okay, the FCC is showing signs of becoming unfriendly and hardnosed about Techs above 147. Big deal. The whole two meter band should have been opened to Techs years ago – you know it, I know it – and the FCC knows it.

If the FCC has any bitch about the way amateurs are giving the Tech exams they should make their gripe public and work out a way to solve the problem. If the technical exam for Tech license is exactly the same as the one for the General license – and it is – then why should there be any difference between the two meter allocations for the Generals and the Techs? Particularly in the 147 MHz segment of the band there is no question of code or CW and that is the ONLY difference between the licenses.

Perhaps there is a little reason to keep the Techs out of the virtually unused CW band at the low end of 144, though little of the CW that does get used there is above the Tech 5 wpm speed limit. This part of the band swings into action during aurora and very slow speed code is the way you work via aurora, not high speed. Be that as it may, the FCC could certainly open 147–148 any time with no harm done to anyone – and they should.

Until they do open this part of the band for Techs, this is not a bad place to put repeater inputs for use by General class licensees where the repeater is down linked to a General class band such as ten meters or the upper part of 20m.

Say we take a 19–79 repeater and put a second priority input on 147.39 which, when used, would have its output on 79 and also on 29.68 MHz. This would get around the problem of Techs being repeated on 10m and keep some of the FCC engineers in charge with nothing better in this world from harassing us. It is too bad that some of them, like Atems in Detroit, have so little interest in the CB mess that they have time hanging heavy on their hands and spend large gobs of our money strictly enforcing almost unbelievable interpretations of obscure and long uneeded rules.

Hopefully your repeater group will take an interest in down links and set up some. This will greatly enhance the value of your repeater. If your group is interested in providing first rate emergency service then you can hardly refuse to set up a down link to the service nets on 40m, Midcard on 7255 and Eastcars and Westcars on 7258 kHz. A simple sideband transceiver connected to your repeater will enable this down link to be used for reporting emergencies. There are hundreds of ears monitoring these nets night and day so you will be able to expand the service you provide enormously by tying into the nets.

Links to 10m will enable you to work through your repeater and out to a western repeater – through a link back up to 2m again. That comes under the heading of fun.

Northeastern Repeater Association

The repeater groups of the northeastern part of the country are now mulling over the constitution and by-laws of the Northeastern Repeater Association (NRA), trying to decide whether they want to join or not.

There is no question that an organization of repeater groups is needed. Every time there is any sort of meeting announced the representatives of repeaters turn out in great numbers and anxious to get on with solving the many problems involved in coexisting. The reasons for some hesitation as far as jumping into the NRA have to do with its short, but checkered history.

The first meeting, held early this year in Pennsylvania, came as a surprise to most of the New England repeater groups, who were not only uninvited, but feel that the meeting was perhaps intentionally kept a secret from them. This meeting seems to have been prompted by a fear by a few people that the FM Symposium announced by 73 and hosted by the Worcester Radio Club would be a success. The idea apparently was to steal the thunder from the symposium, hence the secrecy.

The Pennsylvania meeting resulted in several important frequency allocation agreements and certainly was worth while from this aspect. The NRA was "organized" at this time with Gordon Pugh W2GHR as president and Bob Peterson K2IEZ as vice president. Since both of these chaps are extremely controversial in FM circles this choice spread more consternation than confidence among the New England repeater groups.

The second meeting of the NRA in Weston (Mass.) steam rollered over even the most sturdy voices of protest and did not increase confidence. Bob Waters W1PRI and Bruce Marcus WA1NXG, probably the two most controversial amateurs in New England FM, appeared to be working hand in glove with Pugh and Peterson. More consternation.

The third meeting, in Hartford in April, surprised those present when the announcement was made that the president was now Bob Waters and Pugh was vice president. Peterson had dropped out. The representatives of K1FFK on Mt. Greylock raised a very loud howl about Pugh being any officer of NRA at all in view of his actions with WA1KFX (see page 10, June 73). They felt that this was deliberate jamming of their repeater and that any individual who would do such a thing had no business having an office in a repeater association. The representatives of about 80 repeaters present for this meeting were not happy to find that the meeting was taken over almost entirely for the reading of a proposed constitution and by-laws of the NRA instead of getting down to brass tacks and trying to solve the problems that the groups had come there to work on. Many felt that the meeting was a tremendous waste of time.

After the meeting representatives of repeaters with special problems got together to see what could be done to solve channel problems. Pugh finally agreed at this time to shut down his Mt Snow repeater which was clobbering K1FFK a few miles away. A long hassle with Frank W2OCM came to naught when Frank refused to consider any negotiations, thus forcing the Bridgeport repeater WA1KGK to be the only one in New England not on a 600 kHz pair.

Two months after the April NRA meeting copies of the proposed consti-

(continued on page 136)

Sue Sabin K7TCU
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Twisp WA 98856

THE TAMING OF THE HHRW

What is worse than having TVI? What is more shattering than a pink ticket from the FCC? Well, I'll tell you. An HHRW, that's what. You don't know what an HHRW is? Then read carefully, because you may be married to one. An HHRW is a *Hate Ham Radio Wife*. They come in all sizes, shapes and colors. The extreme species can be recognized by the fact that they find it necessary to bake a cake – using the electric mixer of course – or to do some very urgent sewing on a dress they won't be wearing for six months, always right in the middle of a rare DX contact. Should they come across a ground radial while working in the flower bed, they whip out their pruning shears and cut it into tiny pieces. Of course one consolation there is that it was the ground radial that got it and not you! Their favorite topic of conversation is telling you about the many uses the ham shack could be put to if you would just "get rid of all that radio junk."

Now I am a HWFO – a *Ham Wife of the First Order*. That is a license toting ham XYL. And I am going to give you a few pointers on how to turn that HHRW of yours into an HWSO. A *Ham Wife of the Second Order*. That is a ham wife who doesn't actually have a license, but neither does she despise your hobby. As a matter of fact her attitude varies from "live and let live" to a genuine interest. Either way she has learned to accept you with as much grace and aplomb as the situation permits, for better or worse and ham radio. How do I qualify to give you these instructions? Well, even though I acquired my Technician license before I married W7UVI (I don't think he would have married me otherwise) there were times – and still are a few – when his hobby irritated me to death. So you can imagine what these same things must do to a bona fide HHRW. So if you want to hang on to your wife *and* your radio, pay close attention.

Rule No. 1. Don't call CQ five minutes before you are supposed to go shopping, to the movies, or to your mother-in-law's for dinner. The guy you contact will no doubt be running the new Starduster 13, the greatest rig to hit the market, and it's the first one you have heard on the air. Now I would judge this contact to be worth at least thirty minutes. You only have five, remember? Another possibility is that the OM who comes back to your CQ just happens to have served on the U.S.S. Goldfish, the very same ship you served on, and about the same time, at that. This contact is worth at least one hour. Or consider this: You call CQ and get an answer. You manage to give and receive all the vital statistics . . . QTH, handle, signal report and sign, all in five minutes. Aren't you proud of yourself? You reach to turn the rig off – but hark! What is that you hear coming faintly through the QRM? Could it be? Is it possible? YES, it is! An XYQØAB in Lower Slobovia calling you! You have never even heard one, let alone worked one. But as you reach for the mike to answer him, the hairs on the back of your neck stand up. A quick glance over your shoulder confirms your suspicions. Your HHRW is standing there looking at you and saying, without even opening her mouth, "If you touch that mike I will *kill* you! We are leaving NOW!" So why risk a five minute QSO? If you, like my OM, find yourself compelled to call CQ at these inopportune



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times, try this therapy. Go into the ham shack but don't turn on the rig. Not even the receiver. Grab a dust cloth and start dusting. How do I know your shack is dusty? Because no self-respecting HHRW would set foot in a ham shack, let alone dust it! Or you could pick up the tools you left out the night before when you were troubleshooting the rig. Try sitting down and writing out QSL's. But whatever you do, don't pick up that mike!

Rule No. 2. As you come home one evening to find the baby crying, the older harmonics fighting, and your wife throwing out a batch of cookies she burned because the stupid timer wasn't working – don't head for the seclusion of your ham shack. (That is, if you want to cultivate an HWSO – if you enjoy living with an HHRW, then go ahead.) If you choose the former, here's what you do. Disengage the screaming toddler from your XYL's leg and shut him up. A cookie will usually do it, if you can find one that isn't charcoal. Then send the feuding harmonics outside, or to their rooms, or anywhere out of their mother's hair. You might even try to fix the "stupid" timer. Later, when the kids are in bed and your XYL is ensconced in front of her favorite TV program, you can enjoy your hamming with the knowledge that you aren't adding fuel to your HRRW's dislike of your hobby.

Rule No. 3. This involves the source of all evil . . . money. Or the lack of it. If your wife needs a new coat, the harmonics all need new shoes and you haven't paid last month's doctor bill, don't go out and buy a new Fantastic 4 Transceiver or a new HANDY, DANDY-SOOPER-DOOPER tower. After all, what would you rather have, these frivolous things or a wife? On second thought don't answer that. Just try to use a little common sense and a hell of a lot of will power when it comes to spending money on your first love. Yes, we XYL's know it is your first love, but we appreciate it if you don't keep reminding us the fact too often.

Now if you follow these few rules I can't guarantee you will change your HHRW into an HRSO, but I think it's worth a try, don't you?

. . .K7TCU

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Oakville, Ontario

$5 PREAMP COMPRESSOR

Recently I purchased an HW-100 Heath transceiver, and with it came the need for a mike. I had one, but it was a low-Z high quality thing, and I was faced with the problem how to match this to my high-Z input of the HW-100. I made up a transistorized preamplifer from a circuit in the GE transistor manual. This furnished me with a high impedance output and more signal than I could use.

I had heard about speech compressors, but never thought they could do anything for me. Because after all, my rig had an effective alc circuit, and that should do the trick. And then, one Sunday morning on 10m, I listened to a German station demonstrating his voice transmission with and without a speech compressor. That did it! What a difference it made. The S-meter gained 6 dB and his voice punched through the QRM. It wasn't even funny!

I dug through all my 73 back issues and found two articles on the subject, both by W2EEY (March and June '69). One circuit was his own design, the other a review of a commercially available unit: the "Caringella ACP-1." The specs on the Caringella look extremely good and the circuit is very well designed, but it was priced in the $20 bracket as a kit and rather large. It couldn't be built into an existing transceiver.

The next thing I did was measure just how much compression is needed by watching my voice amplitude on a storage scope. I could see intense and weak speech passages precisely. I found maximum amplitude differences to be 1:20, or 26 dB. So I went ahead and built a Clipper-type compressor that gives easily 20 dB compression without too much distortion. This thing is less complex, easy to build, cheaper, and physically much smaller than other units. I built it on a 1¼ x 1½ in. circuit board, and could squeeze it easily into a corner of my rig. The thing draws 1.8 mA, which I stole from the 250V B+ via a dropping resistor. If you want to play it safe you can stick a zener in there too. The circuit is flexible and features a few minor things that others don't. It takes out low frequency ingredients, particularly below 150 Hz, which makes voices sound as if they came from the bottom of a barrel. Also, gain can be chosen to suit any type of mike, low and hi-Z mikes can be used with output levels from a 0.5 mV–10 mV/microbar sound pressure. Even ceramic mikes with 100 mV output can be used by feeding the signal in at a different point of the preamplifier.

The preamp-compressor has an input impedance of 50 kΩ and output impedance of 100 kΩ. Frequency response (Fig. 1) is flat from 250 to 3500 Hz and drops off softly to –20 dB at 60 Hz and 20 kHz. Input sensitivity is defined to yield an

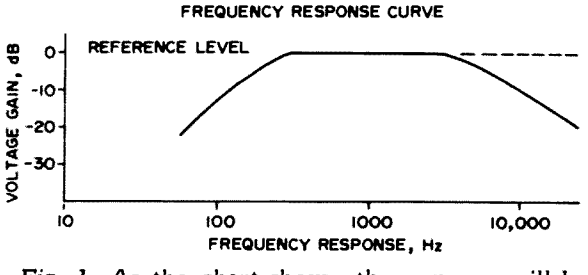


Fig. 1. As the chart shows, the response will be flat in the voice range.

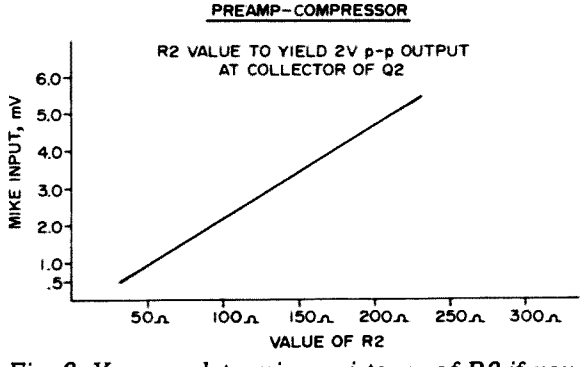
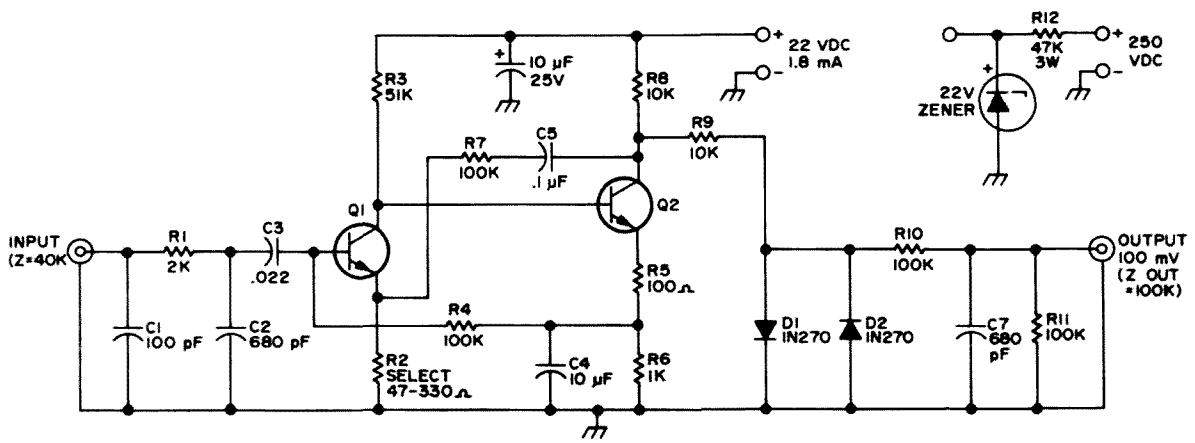


Fig. 2. You can determine resistance of R2 if you know the output capability of the mike you'll be using.



1-Q1 & Q2 ARE Si NPN TYPES, hfe 30-120, VCBo 45V OR EQUIV.
2-SELECT R2 FOR DESIRED GAIN.
3-IF NECESSARY, CHANGE R4 TO YIELD 10-12 VDC AT COLLECTOR OF Q2.
4-IF LOWER OUTPUT IS DESIRED, CHANGE R10-R11 RATIO.

Fig. 3. Schematic, preamp-compressor.

output of 2V p-p at collector of Q2. The gain required can be set by selecting the proper resistance value for R2, emitter resistor of Q1. (See Fig. 2.) If the rms mV output from your mike is known you can select proper emitter resistor from this graph. If mike output is unknown just try 100Ω for a ballpark value; it will most likely do. The whole gain selection is of some importance because the signal at collector of Q2 should not exceed 2V p-p by much. If it does there will be some distortion at the compressed output.

C1, R1, C2 act to filter any rf that gets into the input. C3 couples the signal into the base of Q1. C3 should be a low-Q type capacitor such as an electrolytic to make sure it doesn't pass rf too easily. Q1 amplifies the signal to a 150 mV level. If R2 is increased, gain of that stage decreases and you can input a larger mike signal and vice versa. Q1 is bootstrap-biased from E of Q2 which results in very stable and low distortion amplifier stage. The signal is dc coupled from collector of Q1 to base of Q2. Q2 collector sits at 10–12V dc, which can be influenced with bias resistor R4. Depending if you chose a higher or lower gain Q1 and Q2, this R4 value has to be changed somewhat to get the 10–12V at no-signal. R7 and C5 provide some negative feedback for bass and treble. From the collector of Q2, the signal passes R9 and C6 and sags down via D1 and D2. Here it is important to use the right diodes: they have to be high conductance germanium types which break out easy and gradually. 1N270s will do nicely, and some computer diodes are very suitable.

These diodes will not clip signals as small as 150 mV, but will definitely break out as you increase the signal level. The working resistor R9 and capacitor C7 will smooth off the clipped signal so it looks like a sine wave again. An excessive signal before R9 will cause significant distortion which can be heard easily. The wave shape at the output will look more and more square if the level into the clipper-section becomes too large.

R10 and R11 attenuate the output level to 100 mV, but can be attenuated to other values as well. C7 helps shaping the output wave shape and cuts treble some more. It also shorts any rf at this point.

Since I have been using this compressor over the past few months I made a number of tests on the air, demonstrating my voice without and with compressor. All reports gave me positively more audio punch, and in several cases I could only be copied solid with a compressor – and not without. On DX QSO's voice clarity could not be distinguished except for loudness, whereas local hams in two cases reported a somewhat bassy voice.

So I am sold on it now. I like it because I can sit back and speak gently into the mike even at a 1 ft distance and still observe the output power meter bounce right to the end continuously.

...VE3GSP■

Bud Michaels WB2WYO
713 High Street
Victor NY 14564

Push-to-Talk for the Sixer

AND OTHER MODIFICATIONS

Breathes there an owner of the "Benton Harbor Lunchbox" who hasn't made some modifications to suit his own needs? My Sixer is mounted in a Volkswagen for mobile operation, and I found it hazardous while driving to manually change from receive to transmit using the panel-mounted switch. So, out came the rig for a push-to-talk modification. And while the little fellow was sitting on the workbench with its innards exposed, a few others changes were made: a spot switch and receiver bandspread. These modifications, plus others that had been made from time to time (the output meter and front panel mounted crystal socket were installed following articles in various ham publications over the past few years), have made the Sixer a real joy to operate. I'm sure the basic ideas described here would apply to the Twoer as well.



Author's "Sixer" ready for mobile operation. New panel is not essential but helps to cover up hole left by removed transmit-receive switch. Note new tuning scale.

Push-to-talk capability was achieved by replacing the manual transmit/receive switch with a 12V dc 4PDT miniature relay. Owing to the nature of the filament circuit, once you've converted the rig to PTT, you can't operate on 115V ac, because the filaments are fed in parallel from a 6V winding on the transformer, and when operating from 12V dc, they are arranged in a series-parallel circuit. Since I intended only mobile operation, this situation did not bother me. Since the filaments operate on 6V, a 6V ac or dc relay across the filament string may be used for the PTT, depending upon whether you prefer fixed or mobile operation. People who use these ubiquitous rigs both at home and in the mobile might try installing a rectifier in the filament string before an appropriate dc relay.

The relay is mounted upside down and against the front skirt of the chassis, using contact cement. No socket is used. The

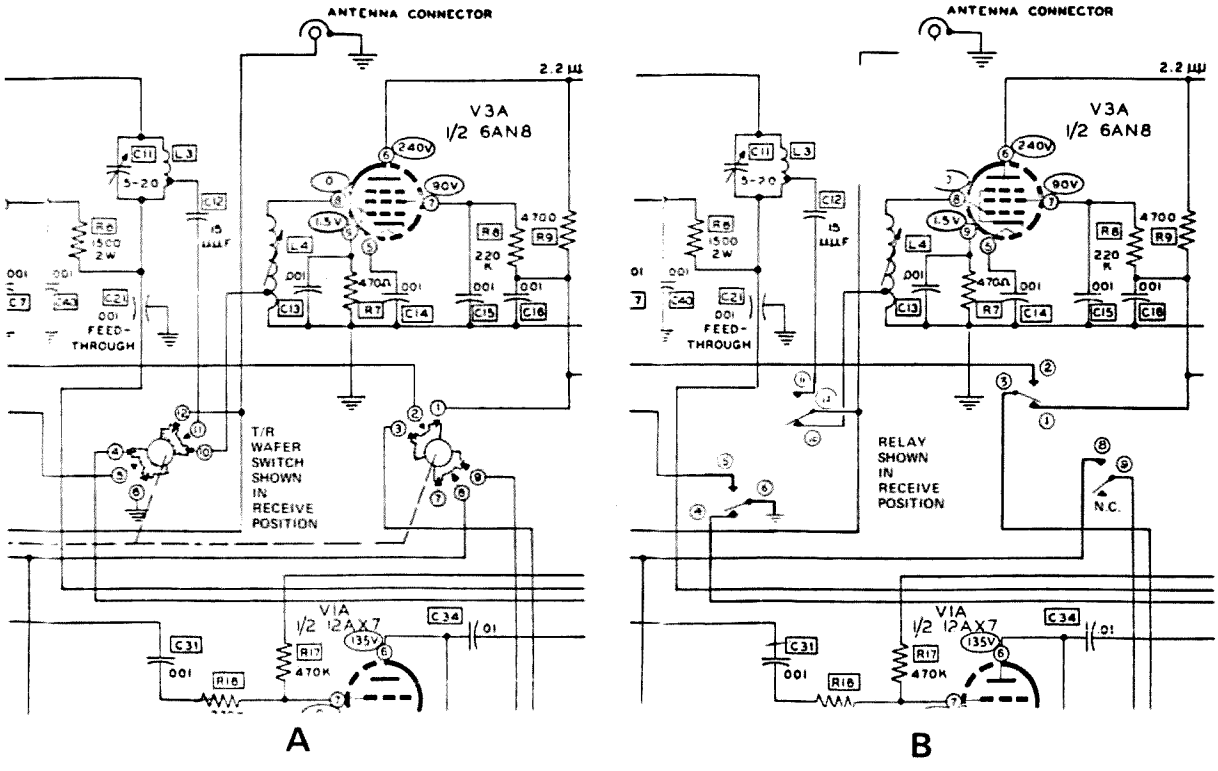


Fig. 1. (a) T/R circuit before modification. T/R wafer switch shown in receive position. (b) T/R circuit after modification. Relay shown in receive position. Numbers in circles around relay contacts correspond to original terminals on wafer switch.

relay occupies the same area originally taken by the wafer switch (see photo), which makes wiring rather easy; just use the wires you removed from the wafer switch and connect them to the relay. Figure 1 shows a "before and after" wiring scheme based on the original Heathkit schematic diagram.

I was a bit apprehensive about making this change, as I felt the intercapacitance between close relay contacts might adversely affect rf output. Before making the change, I measured rf output across a 50Ω dummy load, then repeated the measurements after the relay was installed and the final amplifier retuned. Using my simple measuring techniques, I could detect no reduction in rf output.

Voltage to operate the relay is taken from the 12V filament circuit. Figure 2 shows the relay actuation circuit. The relay is operated by a microphone with a push-to-talk switch built in. A suitable microphone jack can be installed in place of the original jack on the front panel, or on the rear skirt, if you want to add the spot switch described next. Since my Sixer has an output meter, I removed the meter jack and reamed out the hole on the rear skirt to accept the microphone jack. Be sure to use a high impedance microphone.

I can't say the spot switch I added lets you *pinpoint* your crystal frequency on the dial, owing to the very broad tuning characteristics of the receiver. But it is a help when there are several stations around your operating frequency, and you want an inkling of where your signal is going to fall. A SPST (momentary-make or standard toggle) switch is mounted on the front panel and connects a 47,000Ω, 1 watt

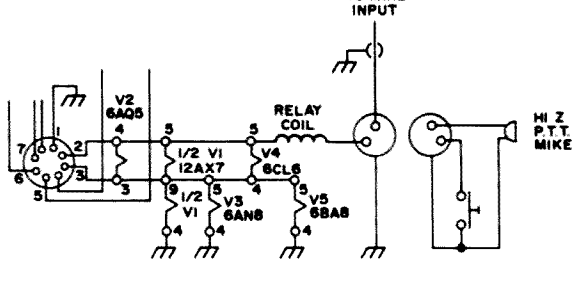


Fig. 2. Relay actuation circuit.

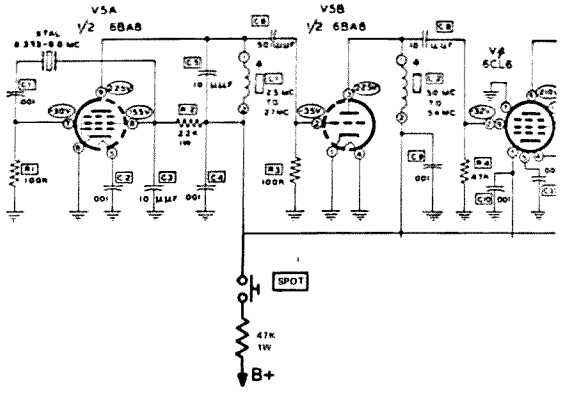


Fig. 3. Spot switch circuit.

resistor between a source of B+ and the plate of oscillator tube V5A, as shown in Fig. 3. The resistor keeps the plate voltage low enough so the oscillator output doesn't overload the receiver, and tends to make spotting a bit more accurate. (Even with this reduction in output, the spot signal covers about 15 degrees of tuning dial rotation!) The broad tuning and lack of selectivity led to the next modification – bandspread.

Bandspread

Most of the activity on six meters in my part of the country seems to fall between 50.2 and 51 MHz, with a great concentration of stations around 50.4 MHz. With the Sixer covering 50 to 54 MHz, this meant that most of the stations I work fall within a two degree span of the dial. Ridiculous!

I very carefully removed one of the two rotor plates from the receiving tuning capacitor, then soldered a 1.5 to 8 pF trimmer across the capacitor terminals. I adjusted the trimmer so that the receiver tuned from 50 MHz to around 52 MHz.

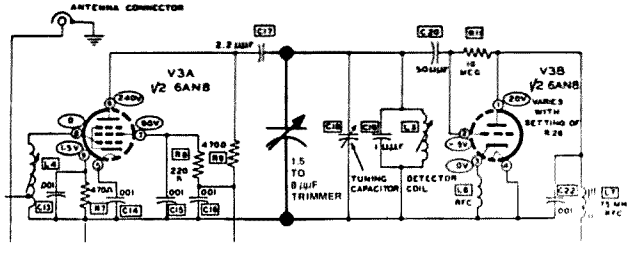


Fig. 4. Bandspread circuit.

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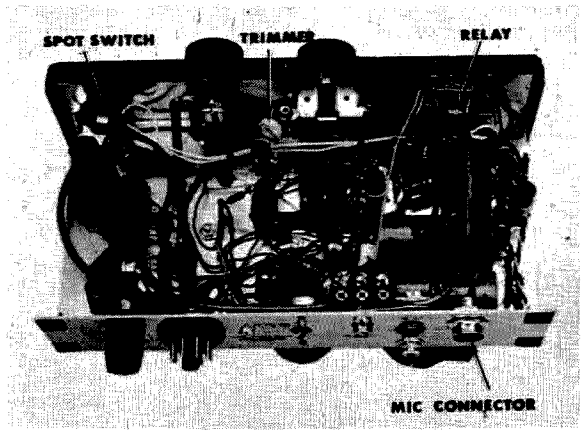
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Sixer underchassis shows location of added components.

This doesn't really change the selectivity characteristics; it merely spreads the stations out a bit. It does make a difference when mobiling, however, and I found it to be worthwhile. Figure 4 shows the circuit change.

My thanks to Bob Wille, K2RQU, for his help during testing the modifications, and to Court Packer for his photography.

. . .WB2WYO■

PAINTING METER BEZELS

William P. Turner WAØABI
5 Chestnut Court
Saint Peters MO 63376

One of the major problems confronting the homebrew artist in making his equipment look as if it were custom-constructed is the American standard black meter bezel. If you happen to like black equipment you are in luck, but if you are partial to green, grey, or brown . . . well, sorry about that.

There is a way of matching any panel color. I stumbled into it quite by accident, after looking high and low for a dark green meter to match SB series green. The same approach is equally applicable to the usual clear plastic bezels found on imported meters.

Your local hobby store, 5 & 10, or drug store sells a paint intended for use on plastic model cars, airplane, and the like which works beautifully on meters. The color selection is quite wide and if you can't find exactly the shade you need you can always mix two or more colors. The answer to my particular problem was one jar of "leaf green" and about 3/4ths of a bottle of black. The price is low, so you needn't worry about the cost of experimentation. This type of paint is very forgiving, it being almost impossible to leave brush marks. Nonetheless, use a good brush and mask off the area to be painted if you hand isn't steady. Your project is guaranteed to look much more professional.

. . .WAØABI

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AUGUST • 1972

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GMT:	00	02	04	06	08	10	12	14	16	18	20	22
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ARGENTINA	14	14	14	7	7	7	14	14	14	14A	21	21
AUSTRALIA	14	14	7A	7B	7B	7	7	7	7	7	14	14
CANAL ZONE	14A	14	7	7	7	7	14	14	14	14	14	14A
ENGLAND	7A	7	7	7	7	7	14	14	14	14	14	14
HAWAII	14	14	7B	7	7	7	7	7B	14	14	14	14
INDIA	7	7	7B	7B	7B	7B	14	14	14	14	7	7
JAPAN	14	14	7	7	7	7	7	7	7	7	7A	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14	14
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PUERTO RICO	14	7	7	7	7	7	7	7A	14	14	14	14
SOUTH AFRICA	7	7	3A	7	7B	14	14	14	14	14	14	7B
U. S. S. R.	7	7	7	7	7	7	14	14	14	14	14	7
WEST COAST	14	14	7A	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

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AUSTRALIA	14	14	14	7A	7B	7	7	7	7	7	14	14
CANAL ZONE	14A	14	14	7	7	7	7	14	14	14	14	14A
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SOUTH AFRICA	7	7	3A	7	7B	7B	14	14	14	14	14	7B
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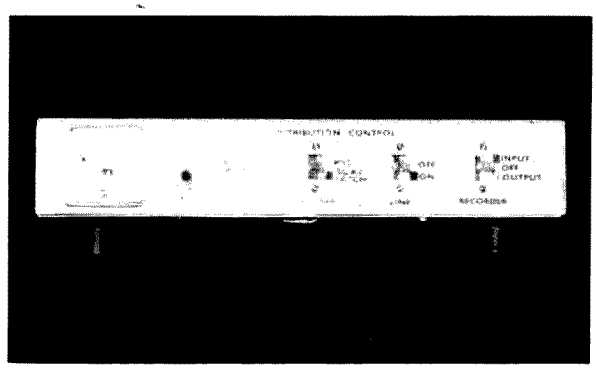
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PUERTO RICO	14	14	7A	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	3A	7	7B	7B	7B	7B	14	14	14	7B
U. S. S. R.	7	7	7	7	7	7	7	7	14	14	14	14
EAST COAST	14	14	7A	7	7	7	7	14	14	14	14	14

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

F. Dale Williams K3PUR
807 S. Walnut St.
State College PA 16801

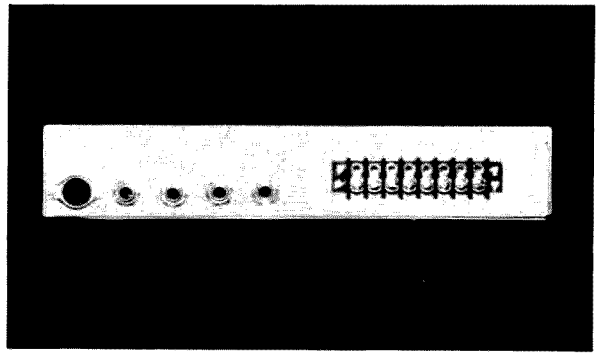
Audio Distribution Control and Phone Patch

Some time ago I decided that I was missing out on some of the fun of amateur radio due to the lack of a phone patch in the station inventory. Therefore one was constructed using junkbox parts and incorporated into another piece of equipment under construction at that time. However, the performance left something to be desired in that the hum level was high (no hybrid transformer in the junkbox), there was no way to monitor the amount of audio being fed to the phone line, and operation required disconnecting cables from the receiver and transmitter, reconnecting them to the phone patch, and reversing the procedure to return to normal operation. A recent redesign of the station made the original equipment which contained the phone patch obsolete, thus giving me a good excuse to redesign and rebuild the phone patch into a separate enclosure.



Front view of Audio Distribution Control

Rear view of Audio Distribution Control.



The audio distribution control unit described here is designed to be used as a phone patch, audio distribution system, and control of transmit/receive functions. Connections to the desired equipment are made by front panel lever switches which incorporate a lamp and different colored filter for each switch position. Different colored filters are supplied with the switches allowing those in different positions to be

color coded similarly when connected for normal operation, phone patch, etc. No extra controls are included for audio level adjustment, since this can be done at the receiver and transmitter. A VU meter is available to assure that the audio level being coupled to the phone line is not above that specified by the telephone company. The meter operates whenever a signal is applied to the hybrid transformer and may also be used to monitor the tape recorder input and output. When S2 is in the Aux/Patch position, the microphone input is disconnected from the transmitter and a DPDT relay is activated. Each of the two activated relay contacts are connected to three terminals on the rear panel and to ground. This arrangement allows transmitter power relays, receiver muting relays, and antenna relays to be activated by the audio distribution control unit when they are connected to the terminal board on the rear panel. This is a good method to activate the transmitter and auxiliary equipment for RTTY operation.

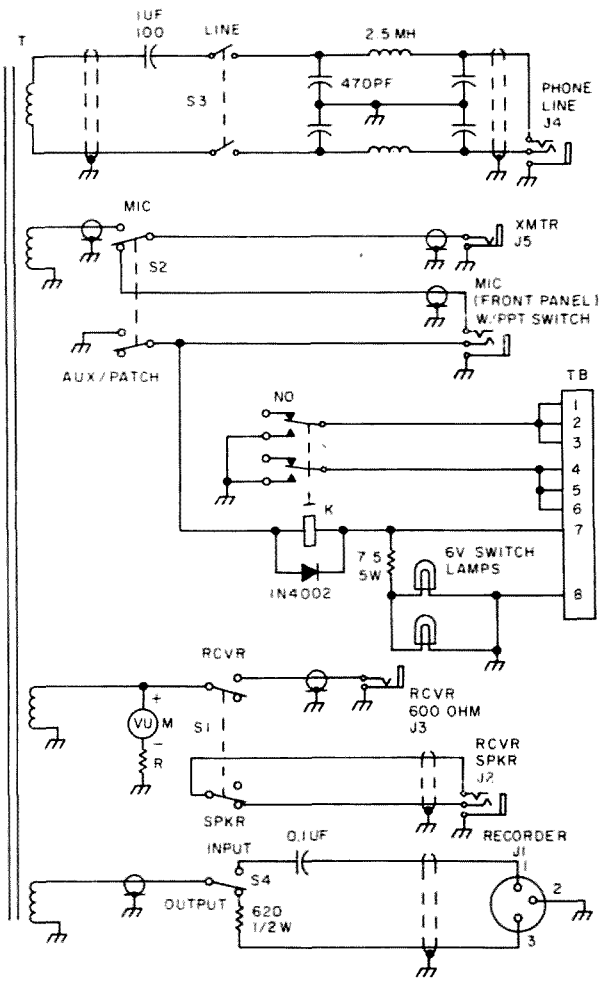


Fig. 1. Schematic of audio distribution control: T – c111 Telephone Retardation Hybrid Transformer, Herbert W. Gordon Company: $5.95. K – 12V, .13A, Sigma Relay Number 50F2, Allied Radio; $3.60. M – VU Meter Number 24A9332, Allied Radio; $3.50. R – Included with VU Meter. S1, S3 – Switchcraft Lever w/Lamp Number 25308, Allied Radio; $3.30. S2 – Switchcraft Lever w/Lamp Number 25312, Allied Radio; $3.60. S4 – Switchcraft Lever w/Lamp Number 25306, Allied Radio; $3. J3, J5 – 2 Connector Phone Jack. J1, J4, J6 – 3 Connector Phone Jack. (Do not use long patch panel jacks.) J1 – see text. TB – Cinch-Jones Terminal Barrier Number 8-140-Y, Allied Radio; $.88. Chassis – Bud 7 x 11 x 2 in., Number AC-407, Allied Radio; $1.80. Bottom Plate – Bud 7 x 11 in., Number BPA-1594, Allied Radio; $.90.

Construction

Although there are many different approaches to construction, the following procedure assures that no necessary steps are left out and that the end item presents a good appearance as well as being functional.

Fig. 2 shows the chassis and bottom cover with the necessary measurements for drilling. All views of the chassis are shown with the open side down, and all measurements are to the center of the openings to be made. Before starting to make measurements, mark the chassis for front, back, and right side. Beginning with the right side, mark and drill the relay mounting screw hole. The small rectangular slot, which keeps the relay from turning after mounting, may be made by drilling one 1/16 inch hole on either side of the center point and squaring with a small flat file. Hold the relay in mounting position to be sure that the holes match, then clean all burrs from the edges of the openings.

Mark the rear of the chassis for the jack openings as shown. The diameter of the tape recorder jack, J1, will be determined by the type of jack used. It may be a normal 3-connector jack, 3-connector microphone jack, or European-type jack as shown in the picture of the audio distribution control unit

Drill the holes for the jacks and assure that they are large enough before deburring. The terminal board, TB, is fitted with wrap-around posts which extend through the chassis. Two methods, depending on the

tools available, can be used to make the necessary opening. If a metal nibbling tool is available, mark a horizontal line 1 inch high and approximately 4 inches long from the right-hand edge of the chassis. Make a mark on this line 1 1/8 inches from the chassis end. Holding the terminal board to the rear of the chassis so that the wrap-around posts are on the line and the right hand terminal is approximately 1/16 inch to the left of the 1 1/8 inch mark, make a point on the horizontal line approximately 1/16 inch to the left of the left hand terminal. Drill a 1/4 inch hole anywhere between the two points on the center line, and use the nibbling tool to make a rectangular opening between the points as shown on the diagram. Hold the terminal board to the chassis and mark the points for drilling the mounting screw holes, assuring that the wrap-around posts are

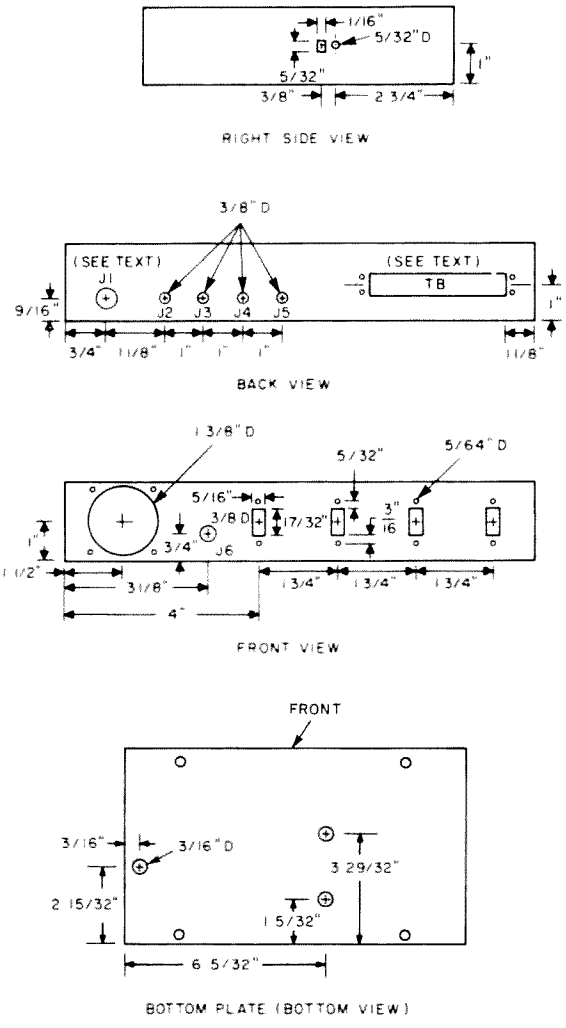
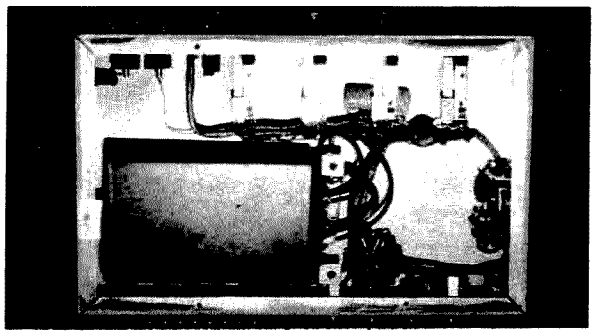


Fig. 2. Right side, back, and front, bottom plate chassis layout.



Bottom view with cover plate removed.

centered in the opening. Clean any burrs from the edge of the opening. If a nibbling tool is not available, hold the terminal board to the chassis so that the wrap-around posts are on the horizontal line and the outside raised Bakelite insulator of the right hand terminal corresponds to the 1 1/8 inch mark on the line. Make points on the line at the center of every wrap-around post and drill 1/4 inch holes at all these points. Hold the terminal board to the chassis and mark points for drilling the mounting screw holes, assuring that the terminal board is parallel to the chassis and all wrap-around posts are centered in the holes. Deburr all openings.

To mark the front panel for drilling, measure 1 inch from the bottom edge of the chassis and draw a horizontal line from one end of the chassis to the other. Make cross marks on this line at all points corresponding to the measurements on the diagram. Check the diameter of the meter housing before making the hole. Points for the meter mounting screw holes can be marked where the screws touch the chassis when the meter is partially inserted in the opening. Be sure that all screws are perpendicular to the chassis and meter plate and the meter is in the correct position before marking the chassis. An alternate method is to make a paper template from the meter or use the cardboard mounting strip from the package. The hole for J6 is drilled similar to those on the rear panel. The openings for the switches may be made by drilling a 1/4 inch hole on the point and using files or nibbling tool. In either case lines designating the perpendicular sides of the switch openings should be drawn on the chassis to preclude making an angular hole. Points for drilling the switch mounting screw holes can be found by inserting the switch lever through the hole from the outside and marking through the

holes on the mounting plate. Be sure that the switch is right side up when inserted, if the chassis is in this position. File all sharp edges and deburr all holes.

An additional three holes are necessary in the bottom cover for mounting the transformer. Mark one long side of the cover "front" after placing it with the bottom side up. Make all measurements with the front side of the cover facing away from you as shown in the diagram. After marking the left edge hole, place the cover on the upside-down chassis, assuring that the front of the chassis corresponds to the front of the bottom cover. Square the cover on the chassis and clamp in position before drilling. The holes may be drilled separately if clamping is not possible. The diameter of the two center holes will depend on the size of the screws to be used. Their length should not be over 1/4 inch. Self-tapping metal screws should be used for attaching the bottom cover.

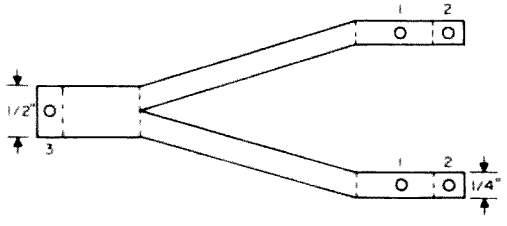


Fig. 3. Transformer bracket drawing.

The shape of the hybrid transformer presents some mounting problems. To overcome these problems, the clamp shown in Fig. 3 can be made from thin aluminum sheet, tin, or some similar material. Exact measurements will depend on the material used, since a lighter metal will bend easily without much loss in dimensions. The V-shaped section fits over the flat top side of the transformer, then both ends are bent down. The holes designated by the number 1 on the diagram are drilled in the center of this section to fit over the bolts on the base of the transformer. The original nuts are used for fastening. Sections numbered 2 and 3 are then bent up so that they are flush with the bottom of the transformer. Place the transformer with clamp attached on the inside of the bottom plate so that sections numbered 2 on the clamp equally cover the center holes and section 3 covers the hole drilled on the edge of the plate. Be sure that the transformer is parallel to the edges of the cover before marking sections 2 and 3 through the bottom plate holes. Drill holes corresponding to screw size and deburr.

Wiring

The wiring of switches always requires concentration and seldom is completed without at least one pair of wires reversed.

A ground bus wire is used at the switches for the connection of the shields of all audio cables terminating at the switches.

As can be seen from the schematic, the phone patch output to the transmitter is direct. For transmitters with high impedance inputs, a matching transformer or transistor preamp will probably be necessary. A diagram for rewiring the first audio stage of the transmitter is included with the hybrid transformer when supplied by Herbert W. Gordon Company. This solution may assist builders with high impedance tube input stages. The .1 μF capacitor on S4 matches a tape recorder input impedance of 2 kΩ while the 620Ω resistor will allow the transformer to see an almost equal impedance with a slight loss of gain due to the mismatch of most recorder outputs. However, gain is not a problem since regulation at the recorder provides more than enough. These values may be changed to suit the builder's needs.

Mount all switches in the chassis, using one screw for each. Since the chassis is upside down, be sure that the switches are the same way. Push the VU meter into position, but do not fasten. Loosely mount all jacks, the terminal board, and the relay.

Cut a piece of number 12 or 14 copper wire or bus wire approximately 1 inch longer than the distance from the first to the last switch. This ground bus should run along the rear of all switches about 1/4 inch from the bottom contacts and all cable shields should be soldered to it. All audio cables should run along the rear of the switches to a point in front of the transformer.

The transformer may be temporarily placed upside down in the chassis and a pencil line drawn parallel to and approximately 1 inch in front of the transformer terminals. All audio cables from the switches to the jacks follow this line to the rear panel where they branch out to their respective jacks.

If cable lacing or clamps are to be used, remember to leave enough slack at the switches, places where the cable run turns,

and the jacks. Begin the wiring with the front panel jack, J6, and continue with the other wiring. The filter components for the phone line may be mounted behind the jack, J4, and the two-conductor shielded cable from the filter to the switch.

The capacitor and resistor for the recorder lines may be mounted between the switch and shielded cable. After completing the audio cable hookup from the switches to the jacks, the audio wiring from the switches to the transformer can be done.

Measure the meter resistor from the negative meter lug to the closest meter mounting screw and cut the leads to this length. Shorten one lead and connect to a solder lug to be placed over the meter mounting screw. Do not connect the meter at this time. After all audio cabling is completed, with the exception of the transformer connections, a continuity test should be performed with an ohmmeter to assure that all connections are correct. When this check has been completed, the cables, with the exception of that section of the cables leading to the transformer, may be laced or tied with cable clamps.

Wiring from the relay to the terminal board should be done next. Do not solder any wires to the terminal board posts until so stated. Keep the wires along the bottom edge of the chassis.

A wire from the open contacts on the relay can be run to the ground bus and soldered. Run two wires from the switching relay contacts to terminals 2 and 5 on the terminal board. Mount the 7.5Ω resistor on the bottom edge of the chassis and bend one lead to pin 7 on the terminal board.

Place a piece of spaghetti on this lead. Run a wire from the remaining side of the relay coil to pin 7 on the terminal board. Attach one wire to pin 8 and one wire to the other end of the dropping resistor. Use insulating tape or shrinkable tubing to prevent the solder joint from inadvertently shorting to the chassis. Run these two wires along the bottom edge of the chassis to the lamp contacts on S1 and connect. Twisted extra pairs can be used to continue the lamp wiring in parallel. Solder all lamp connections. The power wires may now be laced or clamped from S1 to the terminal board if desired. If the previous instructions were followed the lamp wiring will not be laced or clamped with the audio cables and burned out lamps can be easily replaced.

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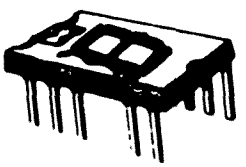


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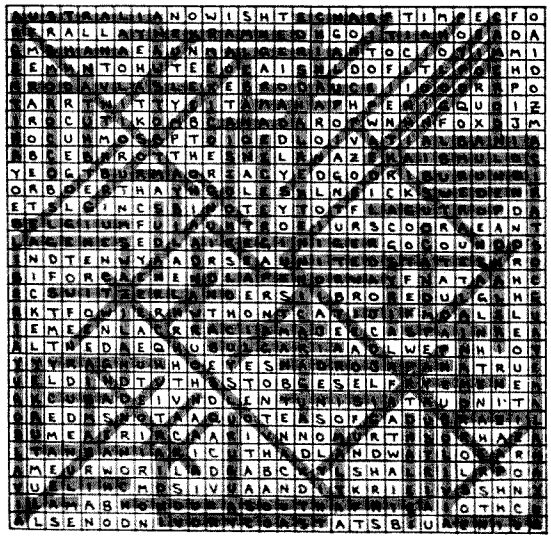
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481 Industrial Ave. Teterboro, N.J. 07608
Phone: 201-288-1619

DX WORD GAME

(see page 145)

Robert H. Nickel WA8OXS
21346 Pembroke Road
Detroit MI 48219



There are probably more DX countries in here — but these are all *we* could find.

When preparing the audio cables for connection to the transformer terminals, keep in mind that enough slack must be left to allow a hand and wrench to be inserted between the chassis and bottom cover to tighten the transformer clamp nuts to the screws which still will be inserted through the bottom cover. At least 1½ inches clearance should be allowed. After soldering the audio cables to the transformer, run a wire from the ground bus to the nearest leg of the transformer clamp. Solder one end to the ground bus and the other end to a solder lug large enough to fit the transformer clamp screw. Be sure that all terminals used as shield grounds on the transformer are also connected to this lug for grounding. A small bus wire will work well. Check J5 and turn if necessary to keep it from shorting to the transformer mounting clamp when the bottom cover is attached.

Operation

To use the phone patch, place the PTT microphone switch to Off. Dial the given number on the telephone. While explaining to the person on the other end of the line what is happening and why he must say "over," turn the audio gain on the receiver down to about one-fourth of normal and put S1 in Patch position. When you are ready to start, put S3 in Line position. The phone line is now connected to the audio distribution control, and throwing S2 to Aux/Patch will activate the transmitter. You may identify through the microphone of the telephone handset and monitor through the earpiece. The receiver audio gain should be set so that peaks are not above "0" on the VU meter. The transmitter audio should be set for a normal meter indication.

To use the audio distribution control unit as a station transmit/receive relay, as in RTTY or CW operation the PTT switch on the microphone should be Off and S2 moved to the Aux/Patch position. All other switches remain in their normal position. In those stations where VOX or break-in CW is desired, the relay in this unit may be used with your existing circuitry, with minor circuit changes in the relay connections.

With this new unit patching, audio anywhere necessary is a simple matter, and the relay offers versatility in controlling station functions.

. . . K3PUR

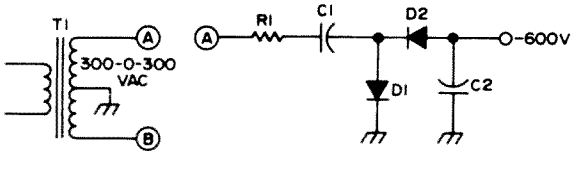
James J. Wenskus, Jr. K2BEH
329 Ballad Avenue
Rochester NY 14626

ECONOMY VOLTAGE MULTIPLIER FOR SCOPE HV SUPPLIES

Smile when your power supply burns up and fills your shack with evil-smelling smoke.

The bulky and expensive high voltage transformers quite often used for scope power supplies are unnecessary and obsolete. Here is a modified voltage multiplier circuit that will replace them. It even uses fewer components than the standard voltage multipliers.

Recently my 20-year-old oscilloscope main power transformer developed an internal short and burned up. I was rather dismayed, as I had built several scopes myself and was quite familiar with the problems involved in the scope power supplies. The power supply was always the least enjoyable, most costly, and most frustrating part of the construction. In this



R1 – 1.5K
C1 – .25 μF, 1 kV
C2 – .5 μF, 1.5 kV
C3 – .25 μF, 1 kV

Fig. 1. Standard voltage doubler circuit.

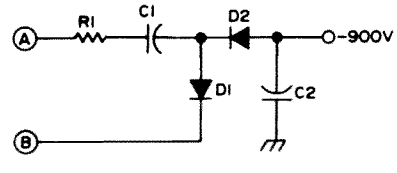


Fig. 2. Modified voltage multiplier. It is now operating as a voltage tripler. If T-1 had a higher rating, such as 375V, this circuit could well be adequate for most scopes.

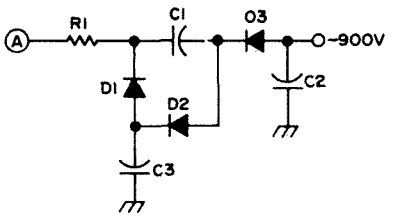


Fig. 3. Standard voltage tripler.

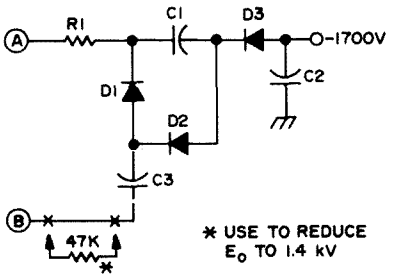


Fig. 4. Modified voltage multiplier. It now appears to operate as a voltage sextupler.

particular case, the possibility of directly replacing the transformer was not practical as it had a special winding to supply the HV to the scope rectifier along with the B+. This meant, of course, that two transformers would normally be required for replacement. With the current cost of transformers as high as it is, the repair prospect was quite gloomy.

I have built several special purpose RTTY oscilloscopes and have always found a considerable magnetic distortion problem to exist when they were completed. In all cases these problems were traced to the 1500V transformers used for the scope power, even though they were described as "shielded." To compound the problem, there is usually very little choice of alternate locations further away from the CRT for this transformer in most scope cabinets. Using CRT magnetic shields was never more than partially effective in these cases. Since these scopes were usually for a relatively non-demanding display, I usually just decided to live with the problem and ignore it. Unfortunately, this was my main development scope that had just quit, and I couldn't stand any magnetic distortion in its displays.

Since high voltage semiconductors are now readily available and quite inexpensive, I decided to go the voltage multiplier route for scope power. I installed a 300-0-300V power transformer to take care of the B+ requirement and started trying the voltage multiplier circuits.

The first circuit that I tried was a voltage doubler. It worked and provided 600V. The scope trace, on a 5BP1, could generously be described as feeble. For some reason I felt particularly inspired that day, so I tried an experiment. I lifted the grounded end of D-1 and connected it to the opposite side, point B, of the power transformer. Well! Three very interesting things happened:

(1) 900V was generated.
(2) The scope trace improved from feeble to mediocre.
(3) Smoke – the 600V capacitor, C-1, shorted.

I obtained some 1 kV capacitors and continued experimenting by going to a voltage tripler to see what it would do under similar conditions. The standard tripler gave 900V as was expected. I lifted the grounded end of C-3 and connected it to point B of the power transformer and:

(1) Pinned the needle on the 1.5 kV scale of the VTVM.
(2) The trace became bright and sharp.
(3) Smoke – all the 1 kV diodes shorted out.

The circuit was rebuilt and installed in the scope. I used 1 kV bathtub capacitors for C-2 and C-3 and two series connected diodes for D-1 – D-3. Shifting to my VOM which has a 2.5 kV scale, I found the output of the circuit to be approximately 1.7 kV. As my original filter capacitor, C-2, was only rated for 1.5 kV, I had to reduce this voltage in order to keep from overstressing it. This was done by putting a 47K resistor in the "B" leg of the multiplier. This brought the voltage down to about 1.4 kV.

I am not familiar with the analysis of this circuit, but I feel certain that someone will eventually supply a nice erudite complex analysis of it, as well as extending its application and modifying it for improved performance.

. . .K2BEH■

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VFO OPERATION FOR THE TWO'er

This article may be of some interest to newcomers in the 2 meter band, or even some amateurs who might be tired of being rock-bound. Maybe you might want to check in on a club net, or break in on an interesting QSO. Vfo operation would be handy on Field Day, or to do a little DX chasing. If you were to buy half a dozen crystals or so, you would have spent enough money to build a good solid-state vfo or perhaps buy one cheap at a club auction.

For this article I used the equipment on hand, which was a Heath HG10 vfo and a Twoer (HW30). The receiver being what it is, there is a disadvantage not being able to spot the vfo frequency on the B-R-O-A-D regenerative receiver. There is a way to solve this broadness. If you haven't already converted your Twoer receiver, as described in an article titled "More Selectivity For The Twoer" in the June 1963, *73* I recommend the conversion. It is well worth your effort! It makes the receiver usable.

I might add that several members of the Hayward Radio Club, including myself, use Twoers on the club net, with the receivers converted as described in the article. We are very satisfied with the results.

The vfo coupling circuit description is simple and parts cost little or nothing. The HG10 vfo covers 80 through 2 meters and is a fairly stable vfo. The output circuit is a low Z cathode follower, with a common ground return. The Twoer uses a Pierce oscillator which does not have a common ground on the crystal oscillator.

This means that the vfo output cannot be directly coupled to the Pierce oscillator.

The vfo was link coupled to an 8 MHz series tuned tank for load isolation and impedance matching. I found it necessary to isolate the 8 MHz tank from the screen dc voltage in the Twoer. C1 of the 8 MHz tank is the dc blocking condenser. The 8 MHz tank was built on a crystal socket holder, so it could simply be plugged in and out.

Perhaps you might want to make a more permanent setup and use a DPDT switch. One thing of importance is to make sure the one turn link is kept from moving once the tank is tuned. The 8 MHz tank is sharp and moving the link will cause detuning. Keep the link secured well.

Tune the 8 MHz tank for resonance in the middle of the band. The length of the output cable from the vfo will change C1 somewhat from the value shown.

The method used for spotting the vfo frequency on the receiver is to key the Twoer oscillator coil (L1) and the B+ bus from the transmit function switch. In the forward direction, the transmitter with the diode works normally. In the reverse direction, it keeps B+ from the rest of the transmitter circuit when the oscillator is keyed. I might add, other types of vfos could be used with the Twoer as long as the coupling circuit remains the same.

As a final comment, I also cannot see why the Sixer (HW29A) will not work with a vfo the same as the Twoer, since the circuit is basically the same.

. . .WB6FVW

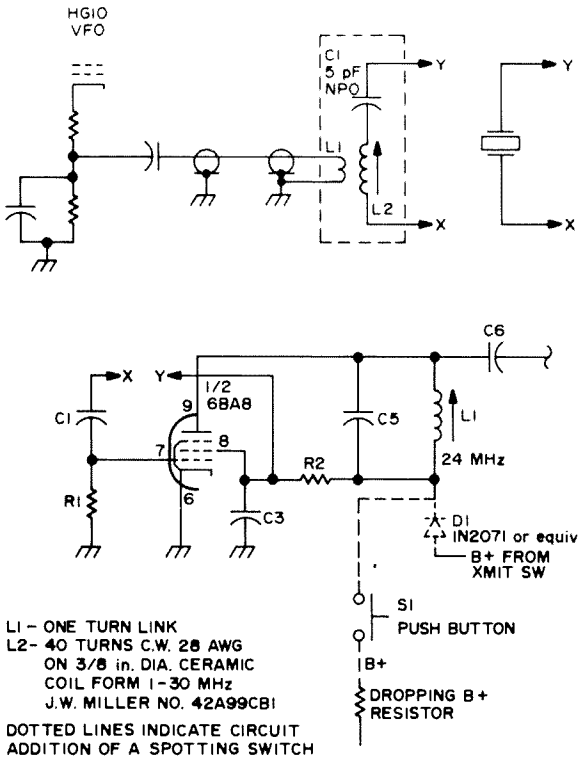
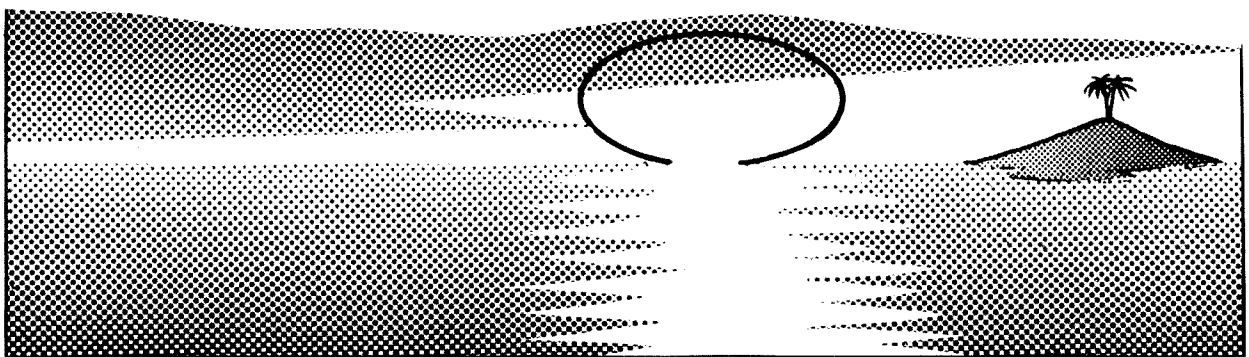


Fig. 1. MHz series tune tank.

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Al Shawsmith VK4SS
35 Whynot St., West End 4101
Queensland, Australia

/MM MANEUVERS

I'll bet you have a secret desire. Every man has his unspoken yearnings, be they paranoic dreams or just wishful thoughts. We all want, at some time or another, to escape from this crazy, phoney rat race or from some personal predicament.

Well, my craving is simple and virtuous. I'd like to sail a small ship and of course equip it with a good ham rig and go /mm. I've never dug deeply into myself to find the real reason, but for years this longing has persisted; it's common enough to many men. Maybe my ancestors were seafaring folk or perhaps it's that eternal situation that man forever creates for himself – a challenge. So whenever the emotion takes me I simply vacate the office and drive down to the city docks and spend rapturous hours watching the small craft come and go. Some from just across the bay, others from across the world.

You might say – "So what? Such a desire should be easy enough to satisfy. Use your spare cash and buy a boat." Yes, but there's one snag; I'm absolutely the worst sailor in the world. The wash from a rowboat is enough to send me to the rail to throw up. I can, if the weather's perfect and I'm dosed with sea sickness tablets, take a trip across the Tasman in a ship about the size of the Queen Mary. However, come the slighest swell and I'm like the proverbial Albatross who as soon as it lands on a vessel is immediately disoriented.

In fact I've been the object of medical investigation and discussion over my problem. At the City Hospital a panel of doctors examined me closely. How can anyone so apparently healthy get so violently sick and go so jelly-like so quickly at sea? Eventually a diagnosis was made and given a medical name. (Don't ask me to spell it, I can't even pronounce it.)

"It's an undue sensitivity, like an allergy, to movement or motion of a certain rhythm. Just keep both feet firmly planted on terra firma," was the professional opinion.

Now what sort of useless advice is that? It's like telling a man with diabetes to eat no sugar. The craving remains, so does the illness – and grows worse.

One day at the office I was having a chat with a psychologist friend of mine, and I told him of my passion for small boats, but that I was an armchair sailor, as they did terrible things to my innards.

"Maybe, but a suppressed desire is bad. In fact," he said, "deny it long enough and you're psychosomatic."

"I'm what?"

"Sick in the head – and all over."

"Really!"

"Yeah. That's what's wrong with half of us. We're too inhibited."

Was he, in a kind way, pointing the finger at me? It seemed I had more than a desire: I had a problem. The conversation was getting

out of my depth, so I was about to change the subject, when he said: "Take my advice and gratify your urge, OB. Try a trip somewhere; a little motion sickness won't kill you."

"Wanna bet?" I said, trying to make light of it.

The phone rang. It was the YF, Helen. "Al, you haven't forgotten that auction sale?"

"Oh, the auction – no, not at all, Honey," I lied. My spirits weren't particularly up. I'd drawn a blank with my last dozen clients and that puts any real estate man down. Auction sales are another form of challenge, but oh no, not today. I wasn't in the mood to face the piles of junk, the stale and musty smells, the odd-bods and general confusion in a big, dirty hall. But the voice on the phone persisted. The YF was not to be put off. It would have been easier to stay the tide.

"Now remember, it's the Oriental five--piece period sun room suite, No. 377 in the catalogue."

"Our sun room's OK," I said hopefully. My rig was set up in a corner of it, and I had no wish to be demoted to the bone-chilling den downstairs. But the YF, determined to carry out her house-proud scheme to every room, had decided to 'restore' it. The renovations would no doubt be artistically done, but my comfort would go in the process.

"Clare Jones and her friend from down the street are going, so see you out-bid them"

So that was it.

"Why aren't you there now? We'll miss out."

"All right Honey, I'll go along and look it over." I replaced the phone; argument would have been useless. My psychologist friend had taken his leave. Outside, the bright sunshine warmed a crisp, clear morning. What the heck was I doing sitting in this dingy, unheated office trying to make a fast buck?"

Delegating the business, such as it was, to my typist for an hour or so, I picked up my hat and headed for the car. "To hell with the auction sale," I mused. "I'll say the bidding was too high." Ahead of me there appeared an expanse of blue water and a flotilla of ships. Stimulated by the tang of salty air I sauntered out along a broad jetty, its rough planking bleached white by sun and flying sand. Thirty or forty small boats, commercial and private, were tied up and in them zestful activity raged. Some of the fraternity were scraping, painting and renovating; others loading and unloading.

A wide variety of odors, colors and sounds assailed and quickened my senses. Two blocks away roared a car-crammed asphalt jungle; here was a new and stimulating horizon. Adventure called.

Every man, they say, has his susceptibilities. Today, the wide expanse of blue water seemed irresistible. The vitality and gaiety of those who live in small ships is alien to the average inhibited city dweller. For the passing hour, at least, the business rat race was unsupportable. Oh, just to get away from it all. Not far north were palm-studded tropic isles, golden sands and an eternally warm sun. I was really letting myself go, mentally.

The sound of loud profanities reached my ears. From the cabin of a commercial type 40 ft cruiser, a voice was raised in frustration.

"The blasted thing was serviced on the last trip. Are you sure it won't 'G'?"

"Yep, Skipper, it's dead as that crate of mullet, aft."

"We're supposed to sail on the turn of the tide. Try the sunofabitch again."

The ship's name, I noticed was "GIDUP'NGO," but something inside wouldn't. Two men were bent over the radio gear. Poking my face through the Bridge window, I said, "Can I help?"

"Er, yep. If yer a radio man, come aboard." A swarthy, mahogany-tanned little man, in a skipper's cap, eyed me, for the moment, suspiciously.

"I'm Al Shawsmith."

"The name's Burns, and this is my mate, Eddie.'

I explained my qualifications. The Skipper waved a hand toward the equipment.

"Take a look – and there's a box of spares if you need something."

The rig proved to be a modern powerful one, with several fixed frequencies as well as GP coverage; also, the ham bands were

clearly marked. A flick of the on/off switch showed the prior blasphemies were justified. A couple of bumps with the palm of the hand on the Genemotor, and it moaned sickly. Further inspection showed a suspect connection in the circuitry. Soon it was humming musically and very much alive.

"It really needs a test out in the bay," I shouted above the auto and local QRN.

"OK – will do," said the Skipper, looking pleased, and motioning Eddie to the mooring ropes. 'Come for a spin?"

Apprehensively I gazed at the restless mass of open blue water.

"I'm a very bad sailor – really bad –," I began.

"What! On a day like this? Why, there's hardly a white horse to be seen."

Yes, it did seem too good to miss: the advice of my medical friend was still fresh in mind. "Right," I said, "Let's go."

The speed of GIDUP'NGO surprised me. There was no wallowing. She rode smooth and fast. As expected, the gear tested one hundred percent on all frequencies. It sure was a natty piece of equipment, and I decided to case the ham bands; something might be audible and this was an opportunity too good to miss – reception being so much better at sea level. The only signal on 40 MHz was weak and unstable, but the call brought me to an instant alert.

"MAYDAY, MAYDAY, VK4 –– calling ––"

Could I believe my ears? Quickly I tuned the transmitter and replied on the frequency, with QRZ.

"Roger, Roger, Al, VK4SS. This is Harry VK4ZZZ. My car has crashed under Barron Bridge. Do you know my position – over?"

"Roger, VK4ZZZ. Your sigs are very weak, but I can copy. Yes, I know Barron Bridge. Are you injured – over?"

"Yes, my leg is jammed under the motor bulkhead. The transmitter power is failing and water is entering the floor – the tide. Please help urgently!"

The voice was strained with pain and shock. Skip Burns appeared at my side. "Was that a distress call?"

"Yes, a chap – a ham like myself – says he's under the Barron Bridge, in the river, and trapped in his car. He's hurt and the water is . . ."

"Yeah, the tide is on the turn. Hmmm, that's a colossal drop; must be eighty feet or more. Why hasn't someone seen him?" He paused and engaged me with direct questioning eyes. "Could be phoney, huh? Check it out; call him again and see how long he's been there."

"VK4ZZZ de VK4SS. Harry, do you read? Please say when accident occured?"

"About two hours ago I guess. Didn't smash through bridge but was side-swiped by some speed maniac; missed viaduct approach and rolled down steep bank into thick scrub and mangroves. Guess no one can see me from above. Have been calling into this transceiver for nearly an hour. Can't see the mobile whip at rear. Think it's broken or maybe this deep gorge is blanketing the sigs. Was about to throw in the towel when I heard your QRZ. For God's sake get help if you can. Are you out at sea or in the vicinity? I seem to be OK except for my jammed foot . . ."

The signal disappeared into the hash. Mr. Burns gazed at the stippled haze of a mountain spur across many miles of open blue water. "Whaddya reckon." he queried.

"Well I'd say he was a ham right enough, but . . ."

"Anyway, we'll have to report it, no matter who he is. Tell him help is on the way."

"VK4ZZZ de VK4SS. Roger, Harry, we are in the area and will contact land base for immediate help. Please QSL?"

No reply, so I tried again, but only QRN crackled in the confined space of the cabin. I switched to crystal control and the shore base frequency and QSP'd the details of the situation and the message received. I turned to the Skipper for further orders. His steady gaze still searched the horizon. "How far is the Barron Bridge from the city – by road? What time would it take by car to rescue––?"

"About three hours on the mountainous strip; that is, if they don't waste time with red tape. It's nearly a hundred miles from town and I can't recollect any nearby service station either."

Mr. Burns remained silent, evaluating the situation. Finally he said, "We can cut an

hour off that time. Anyway I couldn't let any poor bastard drown like that. Eddie, unlash the dinghy, stow it with rescue gear and make it ready for launching." The mate moved with sudden alacrity.

Long since have I been humbled by the whimsies of Fate. The circumstances of any life can change dramatically at any moment. An instant ago this was a pleasurable jaunt; now we were on a desperate dash to save a man's life. GIDUP'NGO was picking up speed and as we neared the open water I contemplated the crashing surf with abject horror. I had been through this before and knew of the consequences. "Oh for terra firma," I said to myself, and then felt guilty at the thought. Right now the rat race seemed less repulsive and the challenge of going to sea in small ships, much less romantic. All that was left was to put on a brave front. Already the landscape was beginning to spin and nausea cramped my midriff. I turned the receiver up in case VK4ZZZ should call again, and fell prone on the nearest bunk. Here the mate found me. "Hey, what's up?" he queried.

"Just queasy, I guess." How could I explain to a man of the sea my 'thing' about motion sickness.

He stood over me, his face a mixture of incredulity, pity and curiosity. "But we haven't hit the rough stuff, yet," he said. I must have looked bad, because he disappeared for a moment, and returned with a brown paper bag, which, of all odours, smelt of dead fish. Suddenly the boat began to pitch and roll, spray and blue water thudded against the porthole. The little ship fell into a trough between two rearing Pacific rollers, and at the same time, the bottom dropped right out of my stomach. I turned my face to the wall.

After what seemed an eternity, the drive of the power engine ceased, and GIDUP'NGO settled, and began to wallow. For some time, the ever-increasing sound of intermittent gunfire had been audible above the roar of the wind and sea, but I was too ill to question it. Now, sensing action was at hand, I struggled up from under a blanket of sea-sickness, and stood propped alongside the Captain at the wheel.

"Was that gunfire?" I asked.

"It was, and we have a problem. The Barron River forms one boundary of a restricted military area. The Army carries out manouevers here, from time to time. The rookies learn how to handle twenty-five pounders and other heavy stuff. All ships get prior notice. I should have remembered, but we don't have to actually enter the zone, only skirt it. If they keep to their range, we're safe."

"Could we call land base and request help from the Army," I suggested.

'Yep," the Skipper glanced at his watch. "It crossed my mind, too, but time is dead against it. We're behind schedule as it is."

GIDUP'NGO nosed slowly toward the river bar. The little craft rose and fell alarmingly in the steep and heavy sea. My mouth was hot and dry; also I had lost control over my knees and remained upright only because there was a stanchion handy for support. I realized that our moment of truth was at hand. Would she clear the bar? At that instant the sound of gunfire broke out again; so close now it percussed our ears. Shells struck the water with a whine and crump.

"Ignore it," commanded Mr. Burns, his eyes glued directly ahead. "We're still outside the official area." Like a plane at unstick speed we were now committed past the point of no return to negotiate the narrow channel. Suddenly there were two grinding and shuddering bumps.

"She's aground," yelled the mate. But GIDUP'NGO rose manfully again, backing up the next roller almost on her bowsprit. Then the deck seemed to explode under me and I was flat on my back in the scupper with the mate bellowing, "Skip, we've been hit. Holed in the port bow by those crazy bastards!"

At this point the world and I began to part company. Vaguely I remember something being dragged over my head – a Mae West. I was either dumped or fell into the dinghy; an oar was thrust in my hands and Mr. Burns was bawling, "Pull, for Christ's sake – ROW!" I made one desperate effort to obey before final oblivion brought blessed release.

. . . . . .

Consciousness returned rapidly (so I was told) as soon as they got me onto dry land. I had lain prone for over an hour, like a beached dugong in the bilge wash of the little dinghy while the Skipper and his mate strove valiantly to prise Harry from the crushed car. Suddenly the world around me reappeared as if from nowhere; there was a bedlam of noise, people shouting, car motors being started and the crunching of feet. The moment was the sweetest of my life; or so it seemed. No movement; I was lying on a stretcher on solid earth. The voice of Skip Burns was giving details to someone. "The other bloke's OK, just a busted ankle – lucky, huh. We're gonna take a lottery ticket on it, but this chap, well, I dunno. He just came along for the ride, to test the radio gear, but he's got a thing' about the sea, and passed out." Someone undid my soaked shirt and something cold was pressed against my chest; a stethescope.

"I'm OK, Doc," I mumbled.

"Yes, but you'd better go to hospital to see why you collapsed––"

A surge of irritation and shame passed through me, at my poor showing. "No," I said, a trifle piqued. "I'm going nowhere but home – but home."

"If you wish it, but I advise you to rest. You're still showing signs of stress." The doctor signaled the ambulance man.

On the trip back to town, the moments of truth, born in the crises when GIDUP'NGO was headed for Davey Jones' Locker, had time to sink in. My passion for life on the ocean wave and going /mm had vanished; it was useless pursuing the impossible. In a way I was grateful to my psychologist friend, whose advice had been to give it a go, and find out. To come to terms with one's self, is to be at peace. I'd be happily content in the shack from now on, even if I had to move it downstairs.

The ambulance drew to a halt. We were home, but my arrival was badly timed, to say the least. Two doors away, at the Joneses, a van was unloading the suite I was supposed to snap up at the morning's sales. The YF had been phoned so she was waiting – but HOW was she waiting. Human-like, I could have used a little sympathy or

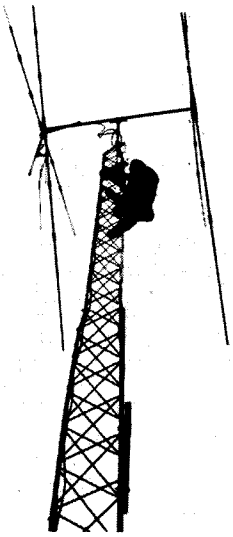
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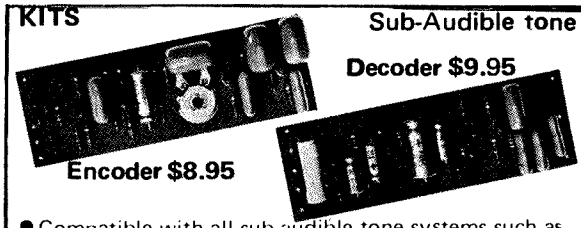
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congratulations over the past happenings. But she stood like an untamed shrew at the head of the stairs, and who can be angrier than a jealous, deceived woman? Before I could open my mouth, she pitched right in.

"Yes, I know all about it. You sneak off to sea when you're supposed to stay put: what a drag you must have been. For one who can't even watch The Cruel Sea on TV without being sick, I must say you're game – or stupid."

How much does a man stand! It was time for my anger. "Look," I said, "quit raving. You're bugged because you lost out on a little odious game of oneupsmanship with the Joneses. My seamanship's got nothing to do with it. We all might have drowned, but all you can think of is your house-proud status. The sun room stays as is, with the rig in it." Feeling I had said enough I made for the bathroom to change and clean up. As I peeled off the wet duds a QSL card fell to the floor. It was Harry's, and on the back was scribbled "Salesman for contemporary and period furniture." Someone must have slipped it into my pocket while I was 'out.' So that was his line of business.

. . . . . .

Helen and I were dressing for a party; a special occasion. Six weeks had now passed since that fateful day. I say fateful, because Lady Luck seemed to have smiled on everyone as a consequence of the rescue.

The impasse between the YF and me over my use of the cosiest room in the house as a shack had been unexpectedly resolved. Harry phoned with a plea, that he be allowed to make me a little gift of some sort: or, was there something Helen could use in the home. What transpired between them, I'll never know, but I'm sure my ham friend is a diplomat as well as a furniture salesman. Yards of lush, rich drapes and carpets arrived for bedrooms and lounge. This was his "little" gift, and it set the YF to redecorating. The sun room was forgotten, and I was left in peace.

Harry presented me with his old mobile rig which worked perfectly, in spite of its dunking. His business firm had given him a new car, complete with a new rig, and to add to the lucky turn of events, between us we had landed a share prize in the city lottery.

Now here we were at an on-board, or ship-warming party to christen GIDUP'NGO 2. The sleek new 55 footer was a blaze of lights, and the small ships' fraternity was there in force. Skip Burns, a bottle of champagne in hand, and looking keen to pour the contents over someone at the first excuse, exchanged banter with all and sundry. Eddie, the mate, already three sheets to the wind, pitched and yawed among the guests; his duty, to keep the glasses full, including his own. Even landlubber Harry VK4ZZZ was there, showing off his plastered leg, and telling an audience how he was gargling the Pacific by the time Mr. Burns 'sprung' him from the car. Cuban Rum punch in hand, he kept the pace with the best of them, getting as high as the mainmast as he told of his lottery win with the Skipper.

A voice broke through the hubbub and salty slang – "Hey Burns, where didya pick up this pretty little packet? Piracy outside the 12 mile limit, or have ya got into the contraband racket?"

"Neither, Bud," The Skipper waved a sheaf of newspaper cuttings. "Haven't ya read all about it? The Army came good with compensation; collected some insurance, too. Then I raised the wind at the bank and Harry, Al and I had a win in the lottery. You'd heardly believe it, would ya?' He waved an arm around at the plush fittings – "So I bought GIDUP'NGO 2, all rigged, furnished, and set for deep sea fishing parties. Got it made, Eddie and me."

Someone suggested a spin. The mate unsteadily prepared to cast off. Those ropes were my umbilical cords to safety – land. I felt a trauma coming on, so it was time to leave. With good luck wishes all around, we waved good night. I knew the friendships made would remain.

Back at the car the YF said casually, "In a hurry to go home?"

"Not really. Why?"

"There s a real super study desk that would just suit the shack. It's on display downtown."

I smiled into the darkness. So the sun room was now my shack. My stint in the dog box was over.

. . .VK4SS.

Osler H. Johns, Jr. W4ZBE
114 Rollins Street
Orlando FL 32804

The SUN and RADIO



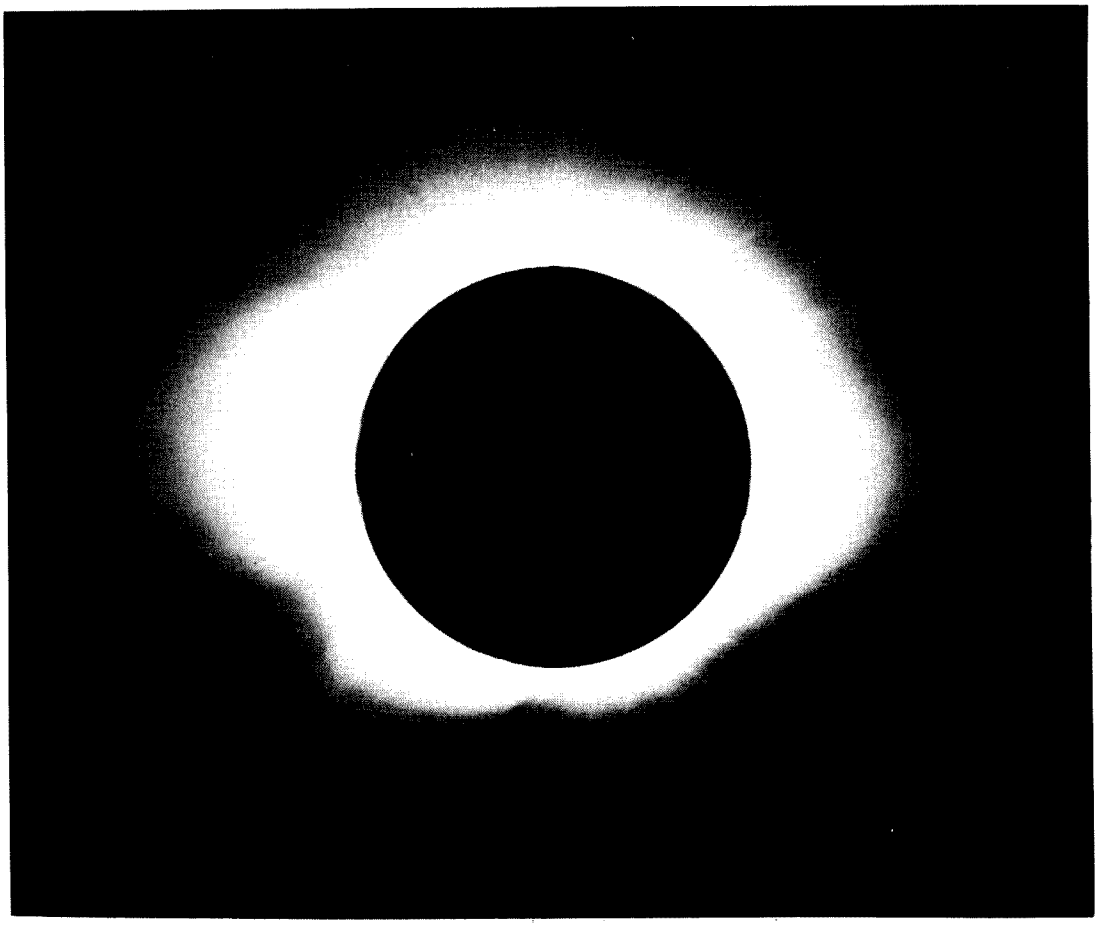
Prominences at the solar limb taken during the total eclipse of Aug. 31, 1932. The black sphere is the moon and the irregularities of the moon's surface can be seen in the photograph. Solar prominences usually occur in areas of high sunspot concentrations and between intense magnetic poles. (Lick Observatory photo.)

Such a statement may seem strange, but as we shall see the sun itself is one of the most important factors in radio communications from several aspects. The sun is a powerful radio transmitter, the cause of the ionosphere, source of magnetic storms and in general the most important factor to radio propagation.

Without the sun no ionosphere would exist and DX on 20 meters would be only slightly greater than that of VHF. As a source of radio noise the sun aids radio astronomers to understand the mechanics of the solar sphere. Whenever solar magnetic storms occur not only radio but landline telephone and telegraph communications are interrupted. The sun is the cause of charged particles being spewed out into space sometimes causing the aurora, an excellent source of VHF radio propagation.

The Sun Itself

Our sun is a very ordinary middle-aged star. But to us it isn't so ordinary. It



The outer corona at the time of a total eclipse on Aug. 31, 1932 in Fryeburg, Maine. Without an eclipse or special instruments, the corona is not seen because of the bright light from the photosphere. The shape of the corona changes with the number and position of sunspots. (Lick Observatory photo.)

radiates some 5 billion horsepower per square mile on the earth and would take 100 earths placed side by side to make up its diameter.

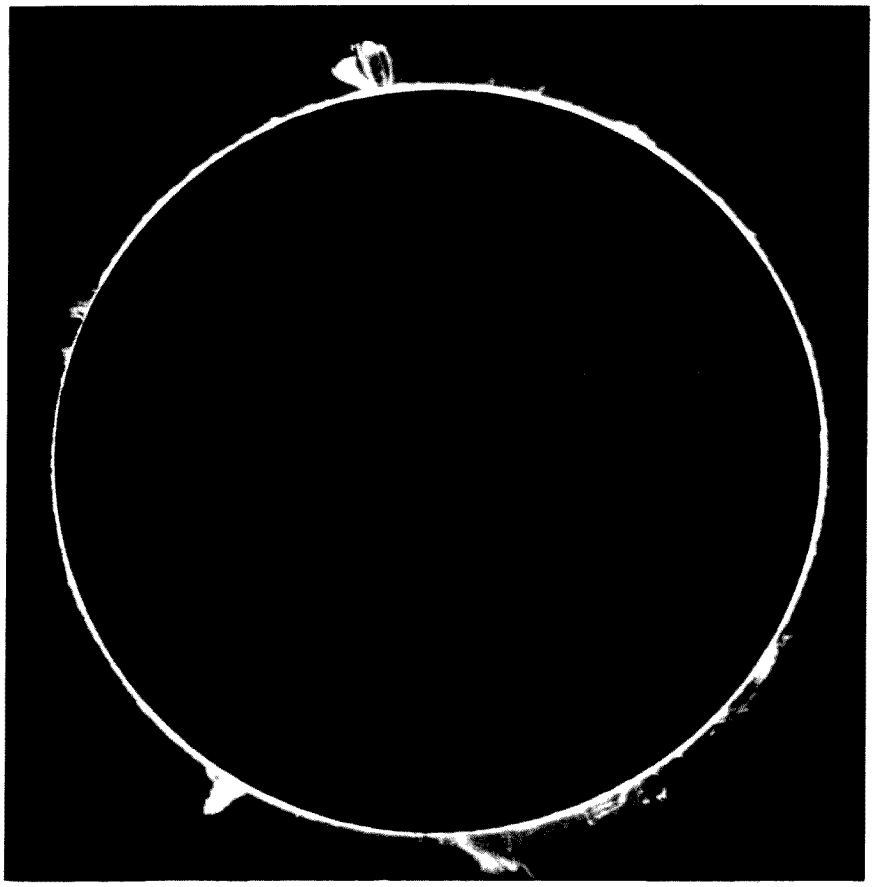
If an observer in a neighbor galaxy were to look in the direction of our Milky Way all he would see would be millions of tiny specks of light, each one a separate sun. Among the specks would be one indistinguishable from all the others – our sun. Possibly, if viewed from another galaxy, our solar sphere and its nearest neighbor star group Alpha Centauri would not be distinguishable as separate objects they would appear so close. However, to give an illustration how far away Alpha Centauri really is, let us imagine that the earth and sun in a model are one foot apart. At this scale, the nearest star would be *fifty miles* away. The human mind can only quiver at the thought of such vastness.

This tiny speck in the universe is in reality 865,000 miles across and 93,000,000 miles removed from the earth.

When we observe the sun, we see a large yellow disk (and we never observe the sun with the naked eye or a telescope not equipped with a good solar filter), called the *photosphere.* The photosphere is the visible portion of the sun. It appears solid but in reality is gaseous like the rest of the sun. The photosphere has a temperature of 7,600 to 11,700°F.

Above the photosphere is the *chromosphere.* This layer, some 1000-2000 miles thick, reaches a temperature 20 times hotter than the surface. Normally the chromosphere cannot be seen because of the bright light coming from the photosphere. However, during eclipses of the sun and with special instruments the chromosphere may be observed.

An interesting note is that in 1895 helium was discovered in the chromosphere of the sun before the element was found on earth.



Prominences. Whole edge of sun taken with calcium K line, December 9, 1929. (Mount Wilson and Palomar Observatories.)

Later we shall delve deeper into the chromosphere because this layer has a tremendous effect on radio conditions at the earth.

American astronomers Harkness and Young first discovered the corona (which extends above the chromosphere) during an eclipse in 1869. This layer reaches outward several million miles above the photosphere, and sears at a temperature of one million degrees.

Where does the sun gain all its energy? Over the past 150 years numerous theories have been expounded stating that the sun's energy comes from combustion, electrical process, and gravitational contraction. None have proved satisfactory. During the last 50 years the nuclear fusion theory has become the standard explanation for solar energy.

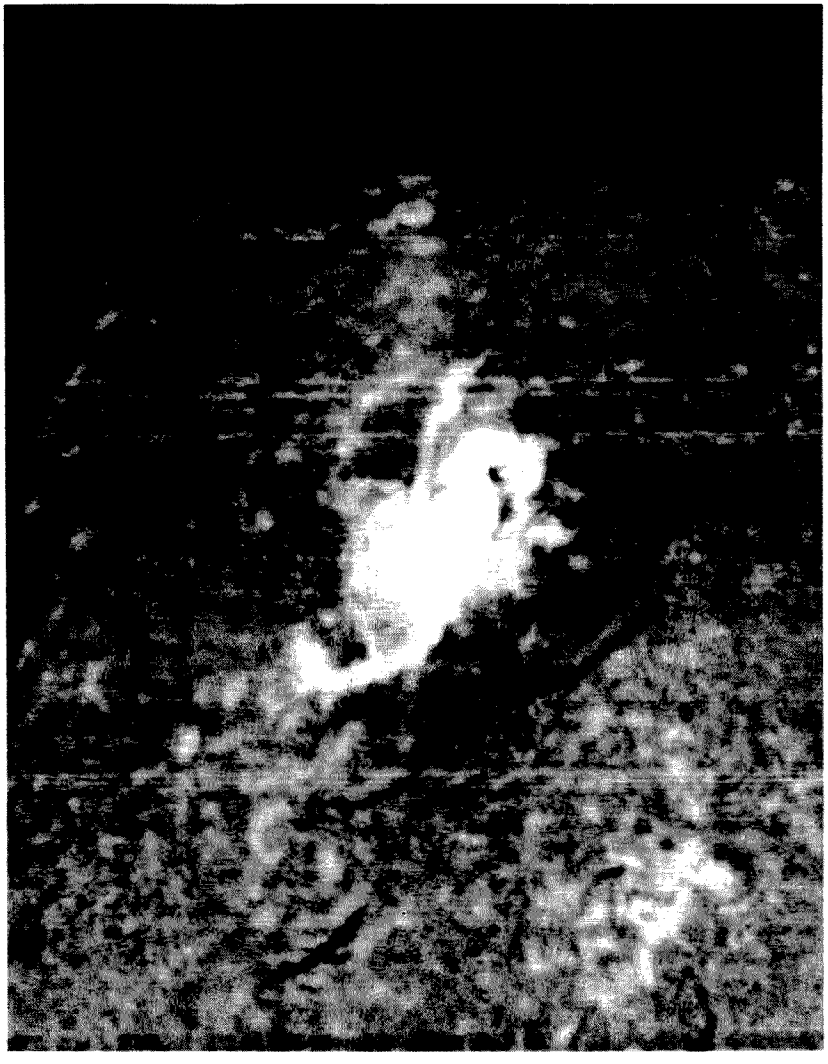
Energy comes from the fusing of four hydrogen atoms into two helium atoms. During the process two helium atoms weigh less than four hydrogen atoms. This extra mass is transformed into energy according to the famous equation derived by Albert Einstein and known to every junior high school science student: Energy is equal to the mass times the square of the velocity of light.

Naturally this process needs very special conditions to occur. The temperature must be at least 20 million degrees and the elements carbon and nitrogen are involved in the reactions.

Each star has a lifespan; like people, plants, and everything else, stars are born, grow, experience a middle age, grow old, and die. Each stage in the life of a star has its own special characteristics.

A star starts out as a large mass of hydrogen gas, very low in density but spread over an area about three lightyears across. Local concentrations or clumps of hydrogen form and, if the concentration is large enough, more and more hydrogen is attracted to these clumps by gravity.

This new star, termed a red giant, is relatively cold and gives off a reddish color. The pressure of the star's material clump-



SOLAR FLARE photographed in red light of the hydrogen a line. 1959 July 16. (Mount Wilson and Palomar Observatories.)

ing together causes the surface temperature to rise to about 1000°F. At the core the temperature might be a million degrees. The process is similar to a bicycle tire pump. When the air pressure in the pump's tube is increased by pressing the plunger, the temperature inside the tube becomes hotter.

After the star has been well formed, the temperature keeps rising. At birth the main source of energy was gravity, but then the temperature increases to the verge of nuclear reaction. This alternating between sources of energy is thought to cause the variability in brightness observed in some stars.

When the temperature reaches 20 million degrees, most of the star's energy comes from nuclear reactions. This is a fully grown star and where our own sun is now in its lifespan.

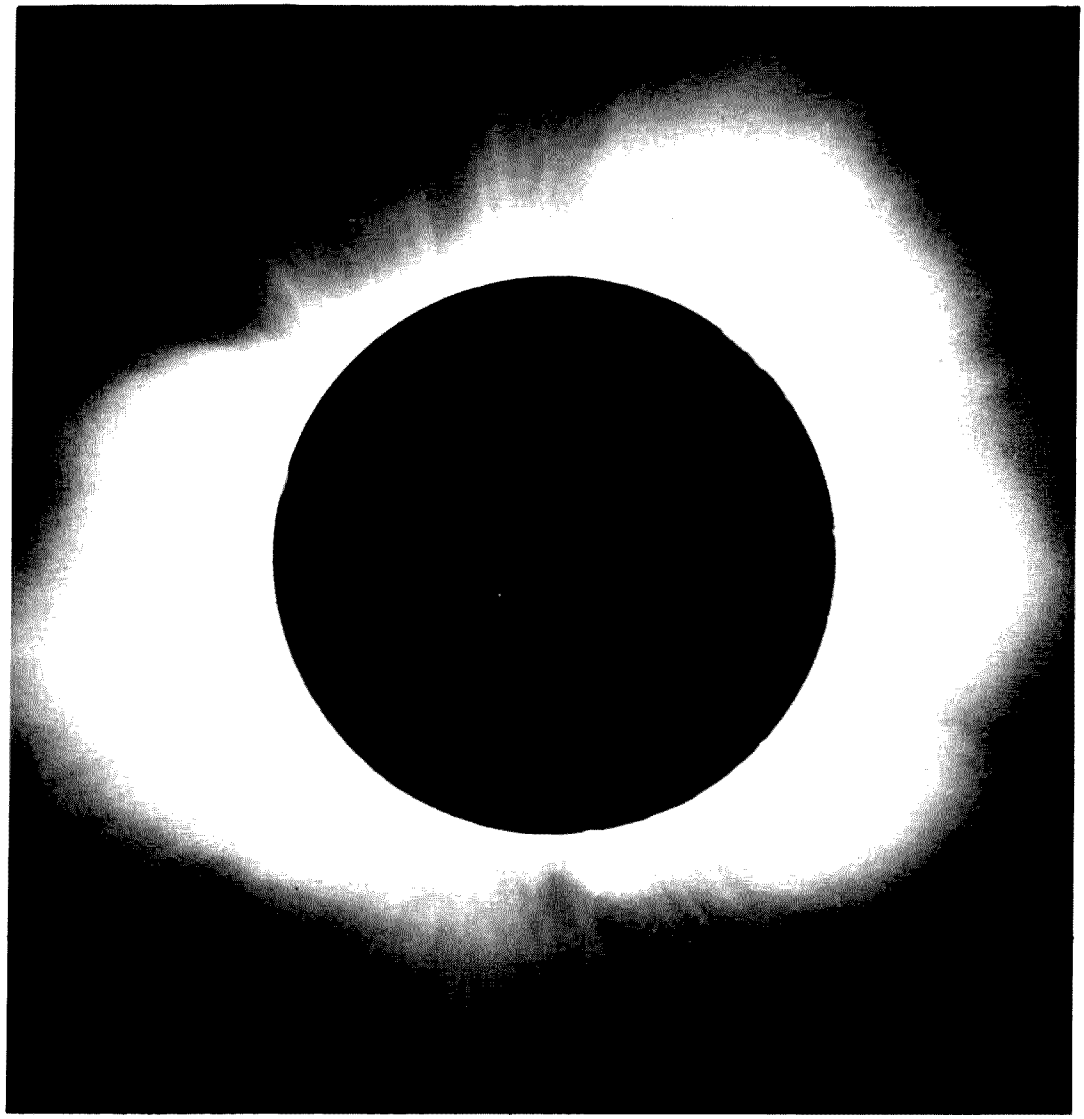
As the sun becomes older, it will become hotter and more luminous, until in a few billion years the earth will experience a temperature far greater than that at which life could exist. The oceans, rivers, lakes, and ice caps will boil away leaving only a scorched rock oribiting the sun.

After the sun's day of glory, it will become fainter and much smaller. It will be known as a "white dwarf" – very hot and very dense.

Finally the solar furnace will fade away, leaving the planets circling a cold, dark mass and the sky in that celestial vicinity will be as black as a moonless night forever.

The Sun and Radio Communications on Earth

The ionosphere exists because of the action of ultraviolet energy from the sun on the oxygen and nitrogen atoms in the upper atmosphere. The ultraviolet energy



Solar corona photographed at the total eclipse of June 8, 1918, Green River, Wyoming. (Mount Wilson and Palomar Observatories.)

frees the electrons from some atoms, causing a layer of ionized atoms and charged particles.

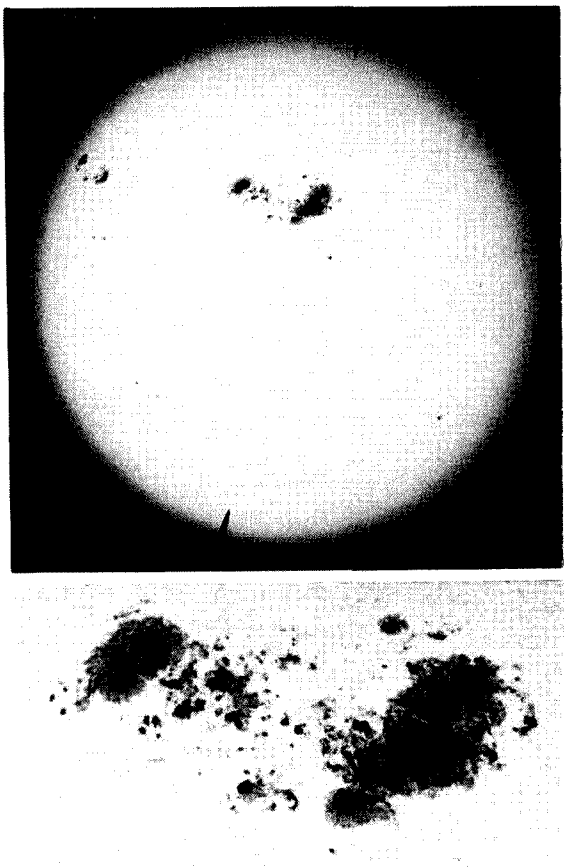
The ionosphere will reflect radio signals if only the right amount of ionization occurs. If the sun releases too much ultraviolet energy the ionosphere will have too many ions. When this happens our shortwave signal is exhausted in the interaction with large numbers of the charged particles.

The ionosphere is divided into several layers, the lowest of which is termed the *E layer*. The E layer forms at the maximum of 70 miles. At 70 miles the air is so dense that free electrons have only to move a short distance to recombine with another atom. Because of this ultraviolet energy must be present at all times to form the E layer. This means that the layer forms only during daylight with the highest concentration of ionization at noon.

During daylight hours, the *D layer* forms below the E layer. The D layer exists only during daylight and tends to absorb the daylight 80 and 40 meter signals. This is the reason distances on 80 and 40 meters are much less during the daytime hours.

The highest layer is the *F layer*, at an average of 175 miles. The air at this altitude is so thin that ions recombine slowly. At night, the ionization level slowly decreases, reaching minimum about 4 a.m. At night the F layer is one layer, however, in the daytime the F layer breaks into two parts (F1 and F2). The F1 is at a height of about 140 miles and the F2 is at 200 miles.

Sporadic E is another part of the iono-



sphere story. Sporadic E patches occur as dense clouds at approximately the same altitude as the E layer. These clouds may occur at most irregular intervals.

All of these layers of the ionosphere occur because of ultraviolet energy from the sun. During times of solar disturbances, sunspots, solar flares, and solar prominences the level of ionization tends to increase.

Heinrich Schwabe, a German businessman and amateur astronomer, in 1843 published his conclusion that sunspots tend to follow an 11-year cycle. Sunspots had been known for over 200 years since Galileo had first noticed their existence. Schwabe, however, first noticed the sunspot cycle.

At various times correlations have been attempted between sunspots and a variety of happenings on earth, from the price of wheat to the average jumping distance of the Australian kangaroo.

However, the sunspot *cycle* does have a definite effect on radio communications. During periods of maximum sunspots, the lowest frequency that an ionospheric layer will reflect is increased. Conversely, the frequency is lowered during minimum sunspots.

There has been a correlation between the number of sunspots and magnetic storms which disrupt the earth's magnetic field. Magnetic storms are most likely when large spots are near the sun's equator and last up to 4 days even after the spots have disappeared.

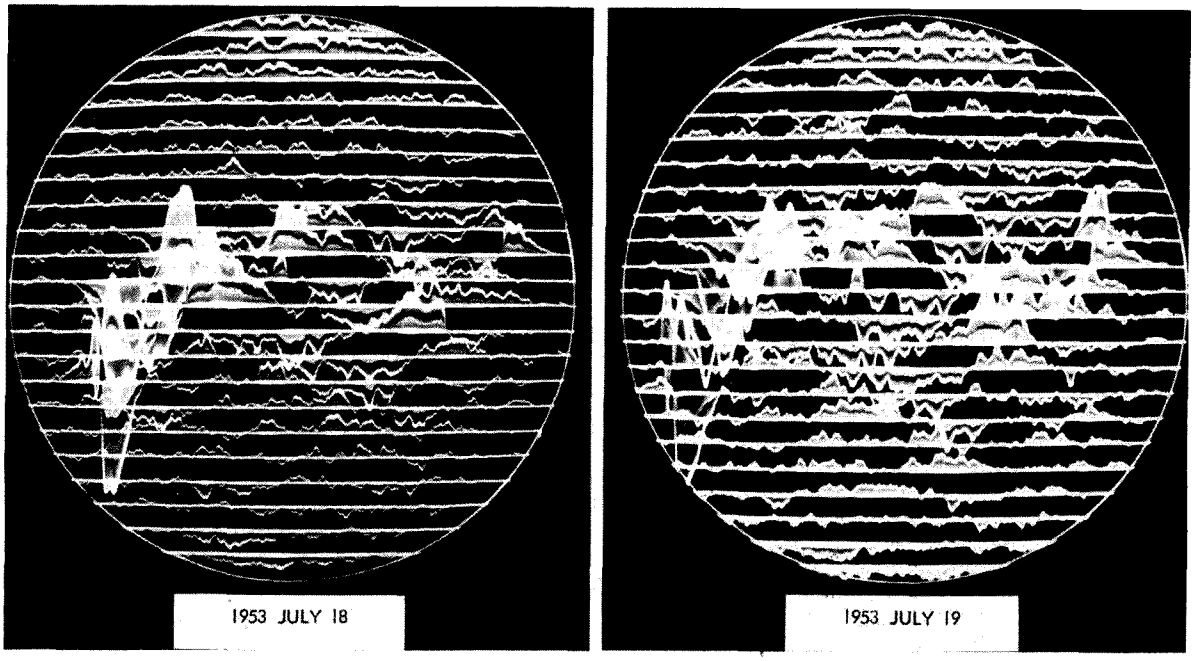
Sunspots cannot always be relied on for predicting magnetic storms. On November 13–14 1894 a large magnetic storm occurred but not a single sunspot was observed. Just the opposite occurred on December 17–20 1946 when no magnetic storm occurred but several huge sunspots moved into the right area of the sun to cause storms.

Sunspots exhibit one of the most powerful magnetic fields in the solar system. When a pair of spots appear a very strong polarity is set up. This field is much greater than anything maintained on earth and several times stronger than the sun's normal magnetic field. The sunspot itself is a mystery 350 years after Galileo's first observation. We know that the sunspot is actually an area that is about 3000°F cooler than the surrounding photosphere, but exactly why sunspots exist we do not know.

The sunspot only appears dark because it is cool in contrast to the hotter photosphere, however, if the sunspot were removed from the surface and put into space it would shine rather than appear black.

Sunspots occur at different positions on the sun during the cycle. During the beginning of a new cycle, most spots occur about 30 degrees north and south latitude on the sun's surface. Toward the end of the cycle most spots have come down to about 15 degrees of the equator. The last group of spots usually turn up at less than 10 degrees in latitude from the equator.

An interesting fact has arisen about the sun from the study of sunspots. The sun being gaseous doesn't revolve at the same rate on each latitutde.



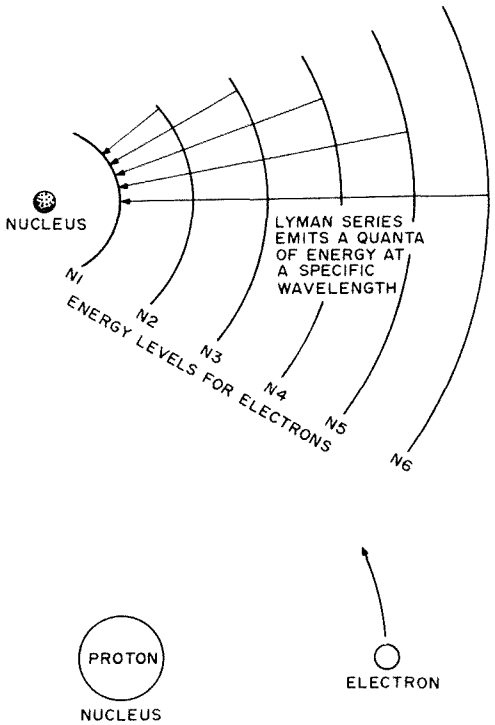
Emission of Ultraviolet Energy

Of great important in radio communications on earth is the emission of ultraviolet energy from the sun. Increases in ultraviolet emission occur at various times usually asssociated with large sunspots and solar flares and can cause communications difficulty. However, a constant level of ultraviolet radiation is needed to maintain the ionosphere.

Let us find out why the sun emits this ultraviolet energy.

The arrangement of hydrogen particles – one electron circling a nucleus – was first described by the Danish physicist Niels Bohr. Bohr's atom has since proved to be inaccurate, though we can use his familiar description of the atom as the nucleus being similar to the sun with the electrons being the planets.

Electrons do not always stay in the same orbit. For hydrogen, there are seven orbits, or "energy levels," in which the electron may be at any given time. Each



time an electron changes orbits a quanta of energy is either released or absorbed. If the electron falls to a lower orbit, energy is released; however, if the electron jumps to a higher orbit, energy of a specific wave-

length of energy is absorbed by the process.

One of these jumps is termed the *Lyman Series*. Only about one atom in a million in the solar atmosphere is excited to this state. However, this is enough to emit energy in the ultraviolet portion of the electromagnetic spectrum.

Along with sunspot cycles, solar prominences and solar flares influence terrestrial radio communication.

When a solar flare occurs, great quantities of ultraviolet energy are ejected into space. This causes radio signals to be absorbed or reflected erratically, destroying reliable communications.

During disturbances of the sun's surface, charged particles are often spread forth. These particles, upon reaching the earth, are channeled by the earth's magnetic field to one pole or the other, depending on the polarity of the pole and particle – thus producing the "aurora."

Every good VHF man knows that the aurora can be used for radio propagation just by pointing the antenna at the "curtain." However, good auroras tend to occur about two years after the sunspot maximum. Why? We don't know. Nobody does!

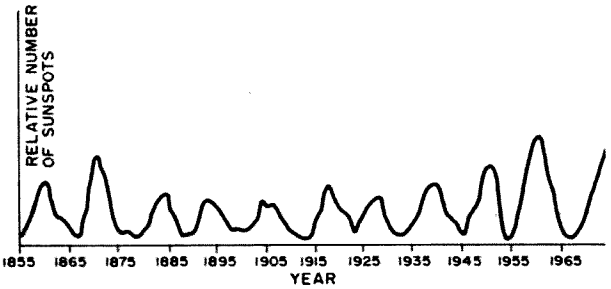
The Sun as a Radio Source

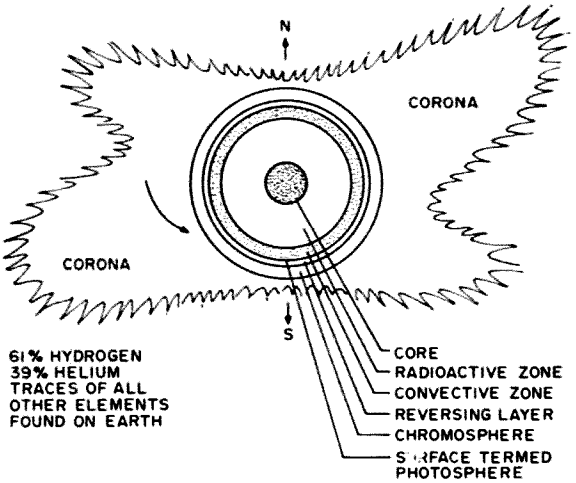
Radio waves make up a small part of the electromagnetic spectrum. The spectrum consits of radio waves, infrared, visibile light, ultraviolet, X-rays, and gamma rays. There is no distinct boundary between these forms; each fades from one form to the next.

The sun radiates all forms of energy along the electromagnetic spectrum. However, the sun itself – along with the earth's atmosphere and ionosphere – filter out most of the energy.

The quiet or undisturbed sun radiates with a constant signal level over several frequencies, originating from the chromosphere at temperatures between 10,000 and 40,000°K. Thermal stimulation of charged particles cause this radio radiation.

In the corona – several million degrees and several million miles out from the surface – is a strong source of radio radiation. This is one reason why the radio astronomer says that the "radio" sun is several times the "optical" sun in width.





The optical sun is very stable. We know this simply by observation. The sun doesn't appear to change in size or shape but the radio sun varies widely in size, shape, and intensity.

When the sun is disturbed, radio noise increases in signal level by a fantastic amount. At times, increases of a millionfold have been recorded. Radio noise seems to increase with solar surface phenomena such as flares, prominences, or sunspots. When large sunspots appear, radio noise can be detected several days before the spot appears and several days after the spot has disappeared.

We often take the sun for granted, little realizing that it is the master of our solar system. It is so massive that it makes our small planet look microscopic. Yet compared with the universe, the sun is so small that the English language has no words to express its small size. Truly, its proportions defy description, be they considered relatively as massive or minuscule. Yet none could deny the gargantuan effect of our tiny giant on earthly communications.

. . .Johns■

Bill Garfield WB9FOP
1704 E. English Street
Danville IL 61832

POOR MAN'S TRANSCANNER

Being an active FM'er, already the proud owner of a Regency HR-2 that was chock full of crystals, you might say I felt as though I were in FM heaven. And I was, until that day in September when I spotted the new Regency Transcanner at the Cincy stagfest. Wow, what a rig! With all the frequencies in use back home, I could sure put one of those to work. Hardly a day goes by that I don't miss a call or two, just because I m listening to the wrong frequency.

Like the rest of you probably, I sure didn't have the $300+ necessary to buy such a rig. What was worse, I couldn't even find anyone who would make a decent offer for my HR-2. It seems at a hamfest everyone wants something for nothing. Anyway, I spent the fifty hard-earned bucks I had with me for some useless knickknacks and left for home.

A few months later, still dreaming of the "super-rig," a friend of mine came to the house to show me his latest plaything. A Regency TMR-8H high band scanner. I thought to myself, "Now isn't this just what this knothead needs – a super-glorified, light-flashing, CB'er's delight fuzz monitor." It wasn't until some time after he left that I started thinking, "Wonder if one of those would work on two meters?"

The next evening after work I dashed to the local CB establishment and asked the guy at the counter to "Lemmesee one-a those' instruction books for one-a dem scanners." The fellow was a little apprehensive at first, but I managed to get it across to him that I had a particular idea in mind, and I wanted to see if this gadget would work. He consented. My hopes were well-founded. The Regency TMR-8H *would* work – perfectly. I handed the guy a check

for the purchase price (slightly greater than one-third the cost of the "super rig" I had dreamed about) and headed for home.

Inside the house I declared the kitchen table a disaster area and scooted the XYL into the boob-tube room. Next came the scrounging of tools and leftover parts from past projects. I took a seat amidst the chaos.

I hurriedly removed the cabinets from both rigs, and began transferring the receive crystals from my HR-2 over to my new Scanner. Then the big moment – the little telescoping antenna in place, the ac cord plugged in, and the power on. IT WORKS! That's Doc working Woody through the seven-six machine twenty miles from here. Not bad!

The sensitivity needed a little improvement though. I instructed the XYL to touch nothing on the table and headed for the local Motorola repair shop. The fellow there is a ham, too, so a quick realignment of a couple of front-end slugs was obtained easily enough. "Gee, sure was way off," I said meekly. "Let's see how the thing checks out now . . . not bad. An easy 0.3 μV for a good 20 dB of quieting. See you later, and thanks!"

The next step was to provide for muting and antenna changeover. No problem at all. The HR-2 antenna lead is already switched by the T/R relay, and looky there . . . an extra set of SPDT contacts that will handle the muting job perfectly. This must really be my day.

In an effort to make a long story short, we'll take up from here with the meat of the conversion information, without all my conjectures.

Start on the HR-2: Disconnect and remove the speaker completely, leads and all. It will no longer be needed. Next, unsolder and remove the little ground lug from terminal 4 on the external speaker block. Add a 3 to 5Ω 2W resistor between terminal 1 and the nearest ground. The chassis will do nicely. Now remove the external speaker jumper from terminals 1 and 2. Carefully drill a ¼ in. hole in the back plate, between the power plug and the speaker terminal board. Mount an RCA type phono jack here. Carefully remove the relay cover and observe the switching arrangement of the SPDT spare contacts. Connect the normally open spare contact to terminal 4 of the external speaker block. Connect the normally closed contact to terminal 2, and the relay tongue to terminal 3. Remove the 10.245 MHz i-f crystal and put it aside for safekeeping. It won't be needed, and may cause problems if left in. Unsolder the coax from the receiver rf deck and reconnect it to the phono jack installed earlier. This completes modifications to your HR-2.

On the Scanner, temporarily remove the speaker, leaving the wires intact. Add a 3 to 5Ω 2W resistor between speaker terminal strip lugs 3 and 4 (ground). Remove the external jumper from terminals 1 and 2. This completes modifications of the Scanner.

Assemble a short coax jumper with a male RCA phono plug on one end, and a male car-radio antenna plug (Cinch #13B or H.H. Smith #1200) on the other. This jumper will be used to connect the antenna switched by the T/R relay of the HR-2 to the Scanner. Using stranded hook-up wire, connect the following terminals together:

Scanner Terminal	to	HR-2 Terminal
1	"	3
2	"	2
3	"	4

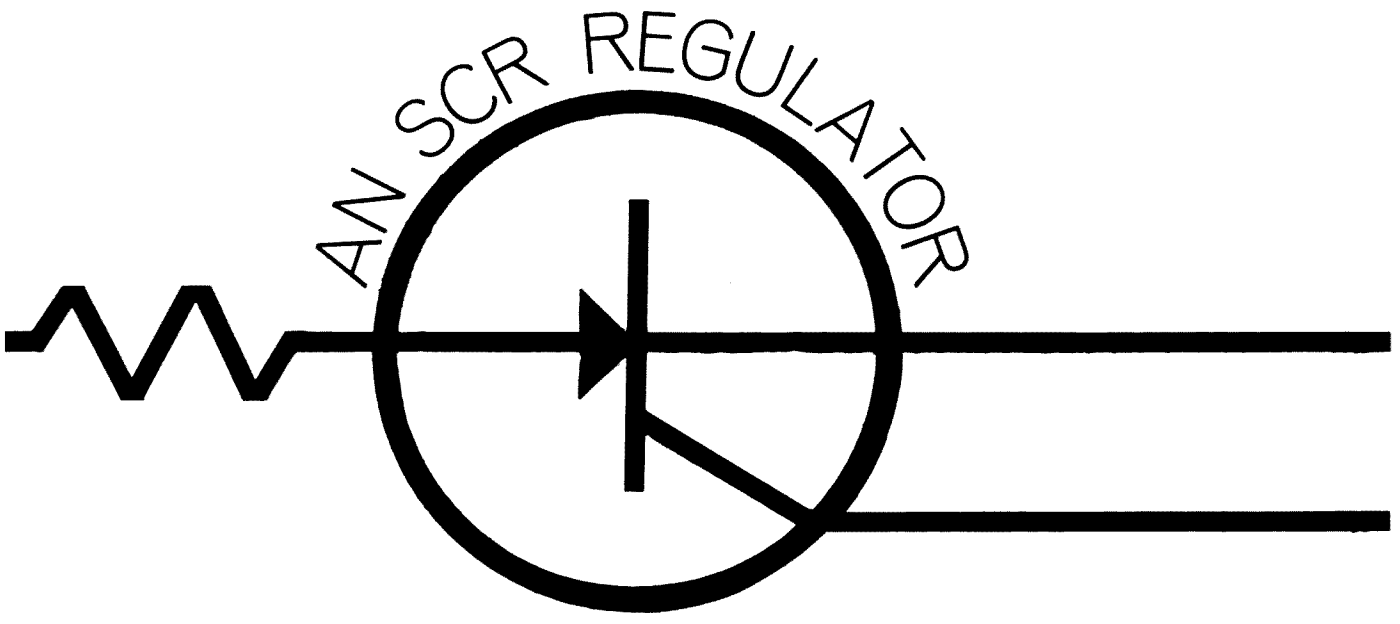
That's all! Now hop in the car, install the two rigs, and have a ball. You may want to connect your HR-2 power cord to a switched position on your car's fuseblock, and the Scanner to an un-switched position. That way, you or anyone else can listen, but transmitting can only take place when the key is in the ignition.

You'll have a little getting-used-to-it to do, as you've gained a few knobs and switches. Don't forget to synchronize the transmitter with the channel you're being called on. Otherwise you may find yourself answering a guy on 82 when he is calling you on 94. Don't feel too bad if you do, though. I still do it occasionally.

. . .WB9FOP

Ed. Note – Since many other transceivers have extra relay contacts, similar modifications can be made. If trade-in value is on your mind, this modification is easily undone.

Ron Sebol W3HXO
8444 12th Avenue
Silver Spring MD 20903

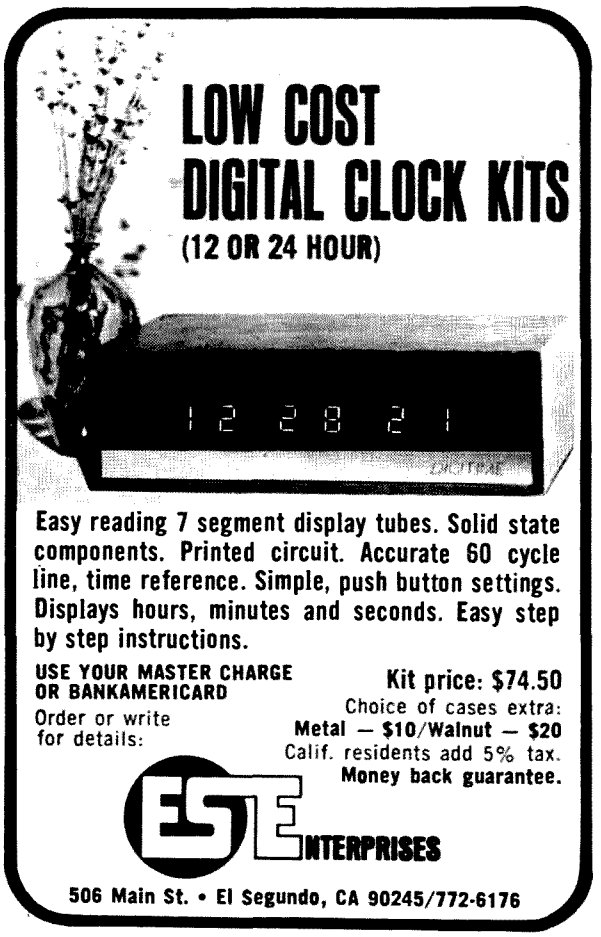


FOR KILOWATT POWER SUPPLIES

One evening when John (K3SGB) and I were talking about our luck in collecting parts for our linear amplifier projects, the conversation eventually turned to the power supply section. We considered the merits of both choke input supplies and capacitor input supplies and found both kinds lacking in one or more ways. For a given capacitor value, the capacitor input supply had more ripple than a choke input supply using the same or even smaller value of capacitance. In addition, the capacitor input supply had a starting current surge problem and poorer voltage stability.

For example, in a 2.5 kV supply, it is common to see 500V variations and extremely heavy starting surges. On the other hand, a choke input supply requires very high bleeder current to obtain the full voltage stability the supply is capable of. Even with a swinging choke, critical current bleeders can waste hundreds of watts. Since John and I wanted to use intermittent-voice-service rated transformers, fixed chokes of about 4H, and a filter capacitance of about 10 μF, we decided to give some thought to voltage regulators because a simple supply represented too many compromises. We soon realized that a regulator would not only eliminate the need for some of the design compromises, but that it would solve the problem of how to reduce the supply voltage during testing, tuneup, and other instances of reduced-power operation. For this purpose a Variac is usually used, but it does not solve any of the other design problems and it would cost as much as a regulator. What was needed, we decided, was a regulator which would allow us to vary the power supply output from a few hundred volts to several thousand volts, while providing excellent regulation and high operating efficiency. With these thoughts in mind I went to work and about one week later had a regulator which satisfied our goals with wide margins.

Since the type of regulator which was built is one which is rarely seen, even in commercial equipment, I have emphasized the manner in which it works rather than the manner in which it was built. This regulator is unusual because it operates on



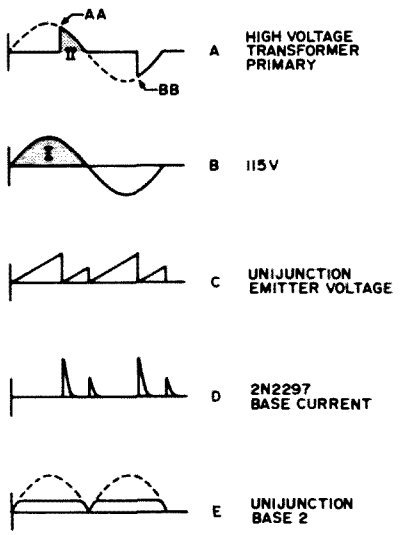


Fig. 1. Pertinent waveforms.

the primary side of the high voltage supply power transformer and manipulates the waveform which is applied to the transformer.

When a voltage such as the one shown in Fig. 1A is applied to the primary of the power transformer, instead of the sine wave shown by the dotted line, less dc voltage will be produced by the supply. This is an important point so let's see what makes it so. In a capacitor input filter, the capacitor charges toward the peak voltage produced by the rectifier diodes. Since the peak voltage of the waveform shown in Fig. 1A is less than the peak voltage of the dotted sine wave, the capacitor input supply output will be less.

In the choke input supply, the dc output voltage is more closely related to the average value (which is proportional to the area) of the rectifier waveform than to its peak voltage. If you look at the area marked II in Fig. 1A, you will see that it is smaller than the area marked I in Fig. 1B. Hence, in both types of supply, less voltage will be produced by the partial sine wave than by the full.

How do you produce this waveform? Equally important, how do you cause the points marked AA and BB to move automatically to the left when the supply voltage is too low and to move to the right when the supply voltage is too high? The answer is that you place an SCR in series with the 115V line and the transformer primary. In this circuit, the SCR behaves somewhat like a single-pole switch. The SCR switch "closes" when it is triggered and "opens" when the voltage across it becomes too small or reverses in polarity. This switch-like behavior of the SCR explains the peculiar appearance of the waveform in Fig. 1A, the voltage at the transformer side of the SCR. Due to the high currents which have to be switched, several SCRs have been paralleled. Figure 2 shows where the SCR bank fits into the circuit. Now let's see how the SCR trigger pulses are generated.

The SCR bank is shown in detail in Fig. 3. In it, the various SCR trigger pulses have to meet several different requirements. The more obvious of these is that the amplitude and duration of the pulses have to be tailored to the individual requirements of the six prime SCRs. Secondly, since these SCRs are combined into a bank, their individual requirements will translate into a combined trigger requirement for the bank. In turn, this will, as you shall see, intro-

duce a need for two additional SCRs which serve as triggers for the others. In turn again, the triggering units will have triggering requirements of their own. Finally, and most important, the trigger pulses must occur at the correct time in each half-cycle of the 60 Hz power line. Let's first consider the timing problem and then turn to the lesser trigger requirements.

In Fig. 4, above the capacitor marked "timing capacitor," there is a PNP transistor. This transistor is part of the section of the regulator which translates a control

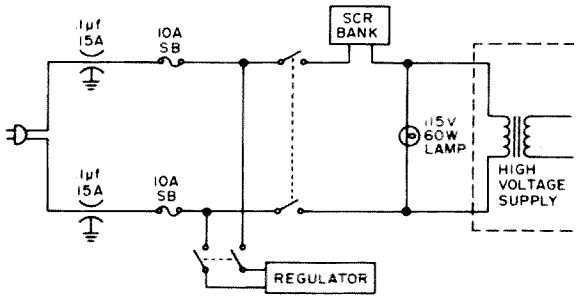


Fig. 2. Ac line connections.

voltage into proportional time delays. In particular, the PNP transistor acts as a variable source of constant current. This is not self-contradictory; the collector current is constant with respect to the collector voltage of the transistor, not its base voltage.

Since a transistor has current gain, a small base current can produce a large emitter current. Consequently, the voltage established by the resistor divider at the base of the PNP is not changed much by the small amount of base current which flows. The emitter and base potentials of a silicon transistor differ by only 0.6V so we find that the emitter voltage is very nearly the voltage which the resistor divider at the PNP base would produce if no transistor were attached to it. This behavior causes the emitter current to be determined by a base voltage, since the emitter load is a resistor whose other end is attached to a fixed B+ supply.

Finally, since the PNP collector current is almost equal to the emitter current, it too will be determined by the base voltage (as long as the collector voltage remains more negative than the emitter voltage). If no other components were present, the timing capacitor would charge constantly until its voltage reached that of the PNP emitter and then it would remain at the emitter potential indefinitely. This brings us to the 2N2646, a unijunction transistor.

The unijunction transistor, like the SCR, is also a switch of sorts. However, the conditions which cause it to switch are different from those in an SCR. Unlike an SCR, which switches when sufficient *current* flows from gate to cathode, a unijunction transistor switches when its emitter *voltage* becomes approximately 60% of the voltage at base two. When a unijunction transistor switches, the resistance between its emitter and base one terminals changes suddenly from tens of megohms to a few hundred ohms. Since the base two voltage, in this particular circuit, is never more than 4.0V, the timing capacitor is never allowed

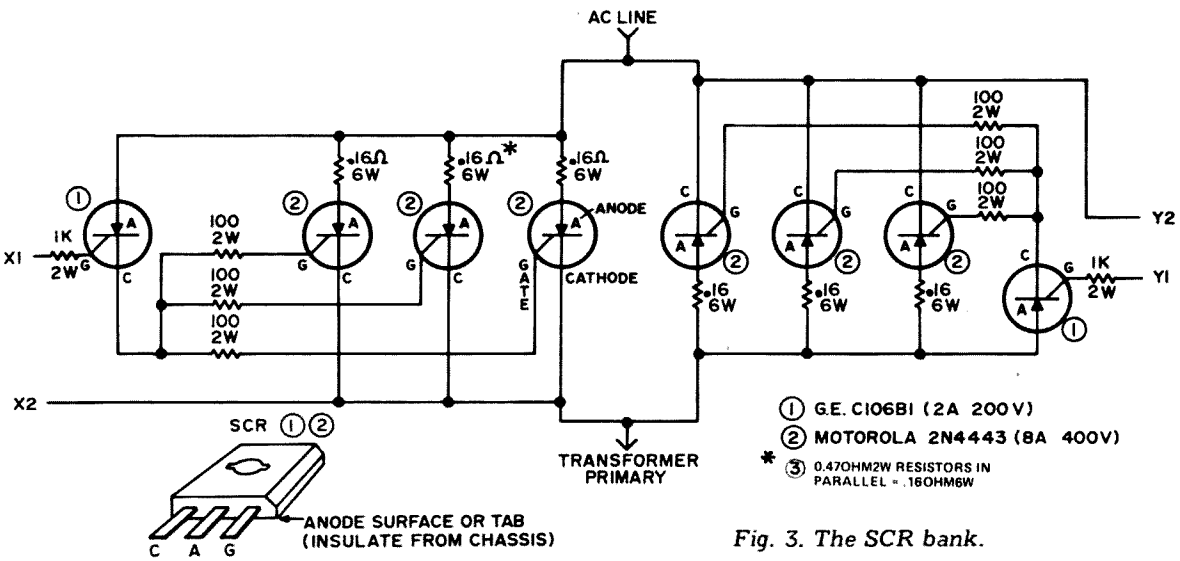


Fig. 3. The SCR bank.

to charge until it reaches the PNP emitter potential because the unijunction transistor will always switch and discharge the timing capacitor to ground first.

Once the "switch" closes, it will remain closed until the current flowing through it falls below a critical value, called the "holding current." The value of the PNP emitter resistor was chosen so that the collector current of the PNP would always be less than the unijunction transistor holding current, thereby insuring the turn-off of the unijunction transistor after the discharge of the timing capacitor. Therefore, if we start following the action at the timing capacitor, a little while after the unijunction transistor has turned off, we will see the voltage rising linearly for a while and then suddenly dropping to very nearly ground. This can be seen in Fig. 1C.

The charge stored in the timing capacitor is dumped in a few microseconds; during the dump, a current of tens of milliamperes flows into the base of the 2N2297 transistor from the timing capacitor, via the unijunction transistor. The 2N2297 further amplifies the capacitor dump current and drives the primary of a 5 μs pulse transformer. The secondaries of the pulse transformer, X1-X2 and Y1-Y2 of Fig. 4, both produce 25V SCR trigger pulses of about 5 μs duration. The emitter current waveform of the unijunction transistor can be seen in Fig. 1D. The smaller ramps and current pulses which you see in the two figures will be explained later.

As you probably have guessed, all of this switching cannot take place without some sort of relation to the ac line. All of the waveforms in Fig. 1A through 1E do, in fact, show just such a relationship.

The manner in which the unijunction switching is synchronized to the ac line is shown best in Fig. 1E. This waveform is the voltage which exists at the base two terminal of the unijunction transistor. This voltage is obtained by full-wave rectifying the 24V transformer and clipping the result with a 4V zener. Remember that the unijunction switches when its emitter voltage is 60% of the voltage at base two. Since the base two waveform becomes zero every time the ac line goes through zero, the unijunction transistor is forced to switch at the zero crossing of each half line-cycle. As a result, the timing capacitor will always have a new voltage ramp beginning at the zero crossings of the line. (If the timing capacitor is charged rapidly enough, the unijunction transistor can be caused to switch more than once during each half line-cycle. This explains the presence of the smaller ramps and current pulses mentioned before.) Since the SCR bank is turned on by the first capacitor dump after a zero crossing of the ac line, the secondary ramps will have no effect and are not important. Now let's get back to Fig. 3 and see what the rest of the SCR story is.

At 2 kW, assuming a power transformer efficiency of 80%, over 21A must be drawn from the ac line. Since an SCR operates in only one direction, there are two of them required, one for each polarity of the half line-cycles. Therefore, each SCR only needs to be rated at half this value (about 10A). This would still provide about a 2-to-1 safety factor because a normal voice waveform has about a 0.5 duty factor. To be extra safe, an SCR rated at 15A should be used.

As for its voltage, 400V gives a good safety factor with respect to the peak voltage of the power line. Rather than buy a pair of new units I used some 8A units which happened to be on hand. As you can see, I hedged the safety factors even more. The bank is equivalent to a pair of 24A, 400V units. The 0.16Ω resistors in series with each 2N4443 SCR insures equal division of the load current. These resistors must not be omitted in parallel operation if a lower current type of SCR is employed.

Due to the leakage reactance of the power transformer, the current drawn from the SCR bank during the 5 μs trigger interval is quite small. Another type of SCR, a C106B1, with a holding current of only 1 mA, is used to get the bank started. The 100Ω resistors attached to each 2N4443 gate lead equalize the gate currents so that each SCR in the bank gets an equal share of the triggering current. The 1 kΩ resistors, connected to the gates of the C106B1 triggering SCRs, prevent the load which is reflected back to the pulse trans-

former primary from becoming too large.

In order to further insure turn-on of the SCR bank, a resistive load was placed in parallel with the primary winding of the power transformer. It was found that a 60W light bulb worked quite well as the resistive load. Without the resistive load the SCR bank would not always behave properly, especially when the high voltage supply was only loaded lightly.

To review, a constant current source, a timing capacitor, a unijunction transistor, and a 2N2297 generate SCR trigger pulses once per half line-cycle. Earlier, it was stated that the supply output could be varied by causing points AA and BB (Fig. 1A) to move to the right or left. More precisely, the time which elapses between a line voltage zero crossing and the first trigger pulse to follow, will determine the supply output voltage. This time delay is inversely proportional to the magnitude of the constant current produced by the PNP transistor. That is, to make the time delay half as large, double the constant current. Since the charging rate of the timing capacitor is controlled, indirectly, by the base voltage of the PNP transistor, we must consider the manner in which this voltage is varied. This brings us to the next major section of the regulator circuit, the IC differential amplifier.

Externally, the differential amplifier looks somewhat like a conventional transistor, except for its additional leads. Electrically, there is a vast difference. Within its metal can there are over a dozen transistors and as many more resistors, connected together to form an entire circuit. In short, it is an integrated circuit. Specifically, it is a differential amplifier. A differential amplifier, by definition, has an output voltage which is proportional to the *difference* of two input voltages, rather than to the voltages themselves. In the National Semiconductor LM201, the kind which was used, the output voltage is typically 25,000 times the difference of the input voltages. In this circuit, one side of the amplifier input is connected to ground via a 1 kΩ resistor. The other amplifier input is connected to a minus voltage reference and the positive voltage output of the high voltage supply. The resistor values have been chosen so that by varying the potentiometer, marked "voltage adjust" (Fig. 4) the supply output can be varied from less than 100V to over 3.5 kV. If the input of the amplifier, at which the minus reference and the positive output voltage are combined, differs from ground potential by even a few millivolts then the amplifier will produce several volts of corrective action at its output.

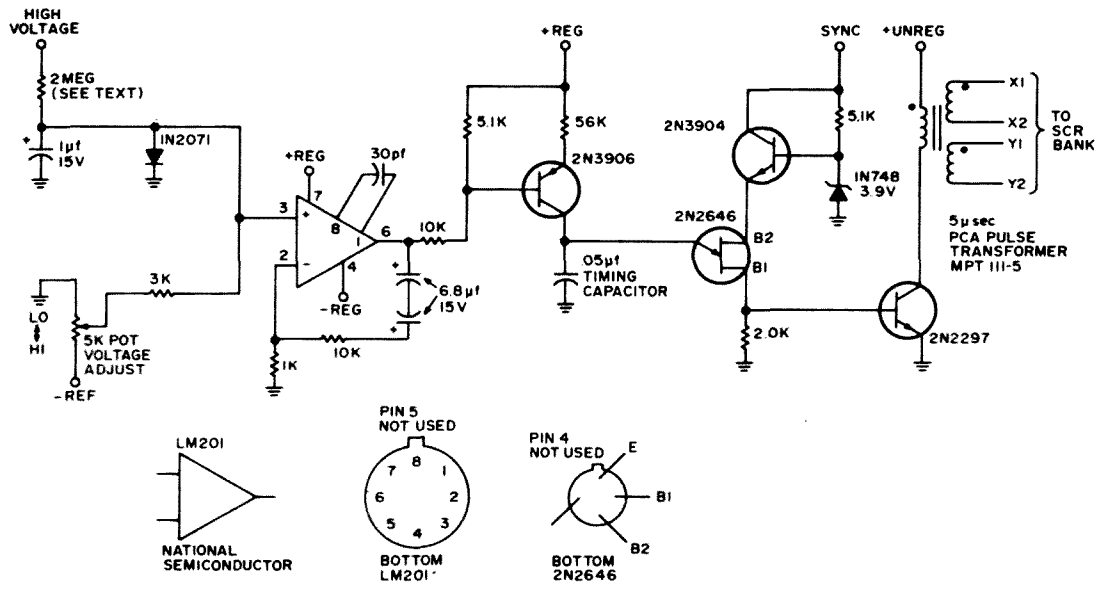


Fig. 4. Error amplifier and trigger generator.

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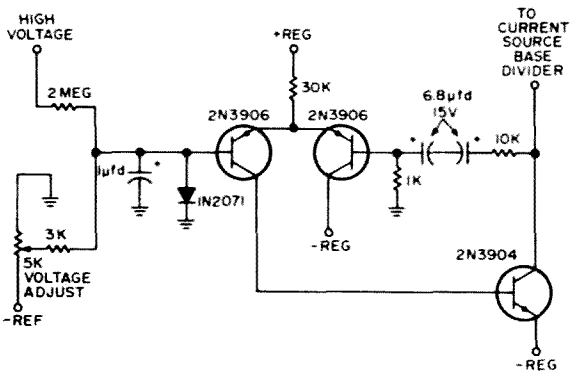


Fig. 5. Cheaper differential amplifier.

This particular differential amplifier costs about $13, a price which some of you may prefer not to pay. This amplifier is so good that it almost overkills the problem. Since the regulator circuit will work with other amplifiers, you may want to try a cheaper unit just to get the regulator on the air. There are many fine IC amplifiers available at less cost; if you use another type be sure to get the data sheet for it from its manufacturer. Follow the manufacturer's recommendations or you will probably end up with an oscillator instead of an amplifier.

If you would prefer to build your own amplifier, you can try the one shown in Fig. 5. It should cost less than $2 even if you buy all of the parts new. I did not try the cheaper amplifier so it may not be completely compatible. If any tweaking of values is required, the parts which are most likely to need the tweaking are the 6.8 μF feedback capacitors and the 10 kΩ resistor in series with them.

I have used the three-transistor amplifier in other circuits and found that it usually has a gain of 300.

With a constant load on the supply, you should see a voltage of nearly zero at pin 2 of the differential amplifier. You may wonder why this pin is not simply grounded. The reason is that the speed of response of the amplifier must be reduced. Due to the high gain of the amplifier and also the fact that only one corrective decision can be made in any given half line-cycle, the regulator would hunt around for the correct voltage without ever finding it. During one half line-cycle the regulator

would produce a minimum time delay and in the very next one it would produce a maximum delay. The three components which are connected to terminal 2 of the amplifier prevent the overcorrections from occurring.

Finally, we get to the regulator power supply. There is nothing unusual about it aside from the fact that one of its outputs is an unfiltered full-wave rectified sine wave. Zener diodes and emitter followers provide a regulated B+ and two regulated B– voltages. The complete power supply circuit is shown in Fig. 6.

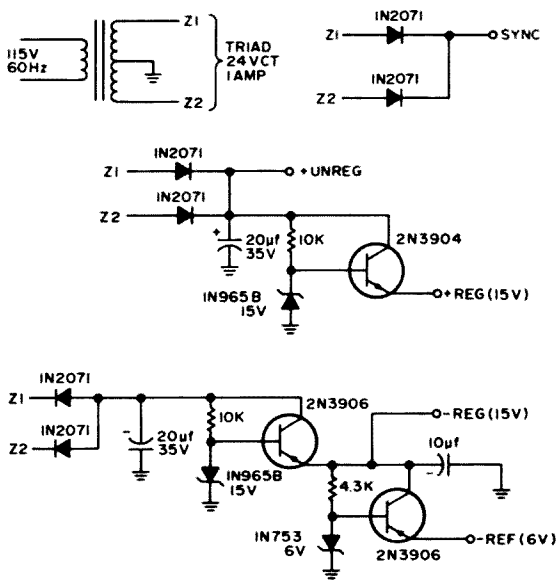


Fig. 6. Regulator power supply.

There is not a great deal to be said about construction of this circuit, because there are no hidden traps awaiting you. Obviously, with a very high gain amplifier you should keep the lead lengths at its input short. Also, since large currents are being switched, you should use sufficiently heavy wire, fuses, switches, etc. Finally, again because currents are being switched, you should enclose the circuit and not omit the 0.1 μF line filter capacitors. The unit I built was contained in a 2 x 5 x 7 in. chassis and the regulator circuit was placed on a 3 x 3 in. printed circuit.

One more caution: Use ten 200 kΩ resistors in series, rather than a single 2 MΩ resistor, in the return from the supply output to the amplifier input, in order to stay well within the resistor manufacturer's maximum voltage and power ratings. The 2W size is fine.

Now I am sure you will want to know how well the regulator circuit works. To test it, I borrowed a Heath model HP-24 kilowatt power supply. This is a capacitor input filter supply which has a no-load output of 2.5 kV. A knife-switch-controlled dummy load, which drew 600W from the supply, was assembled. (For safety, the knife switch was operated with a 1 ft wooden dowel.) Without the regulator, the supply dropped from 2.5 to 1.9 kV when the load was switched in. With the regulator, the supply was set at various voltages below 1.9 kV with no load. After the load was switched in, there was no net voltage change discernible – not even one meter pointer's width! I checked the transient response at a 1.9 kV setting scope and found that the supply voltage dropped 80V when the load switch was first closed. One half line-cycle later, the voltage had recovered 40V out of the 80V, and during the next half line-cycle, the remainder was recovered. I had no way to test the supply with voice modulation; however, I think that the 600W test was severe enough to be representative. As a guess, I would expect to see about ±50V variations with the Heath supply and voice loading.

The switching hash level was checked with a receiver which was plugged into the same line as the regulator. With no line filtering, there was no hash on the bands above 40 meters and the hash was only about S7 on 40 meters. On 80 meters it was quite loud. If you use the 0.1 μF line filters and keep the rest of the circuit in a small chassis, you should not have any hash problem on any band.

As a final check, a 14A electric heater was used as a load and the regulator was run for 15 minutes. After the 15 minute trial, nothing was more than lukewarm, except the electric heater.

If you do decide to try building this regulator, don't make it your last project – 3000V power supplies are dangerous!

. . . W3HXO ■

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Until recently, "Juge" has been a new name to most of you, I'm sure. The first question we get is "How do you pronounce it?" Answer. . . it rhymes with huge". In order to induce you to trade with that guy whose name you can't pronounce, we've gone overboard to provide something different in ham stores. We started in business just over eight years ago, and built our new building two years ago. It has been called the best looking of its kind in the U.S. by every single factory man or out-of-town visitor who has seen it. We stock most major brands, and a good selection of used equipment. We select our merchandise carefully. . . as if we were going to use it ourselves. (All of our sales and service personnel are licensed hams.) We specialize in personal service to our customers, and treat each one as an individual with his own special interests and his own unique needs. We also realize that when you write to us for prices or information, you want an answer now, not two weeks from now. . . and you'll get it! When you order from us, we know how it feels to finally decide to make a purchase. . . your only regret is that you didn't order last week so you could have it now. Normally, your order will be shipped the day it reaches us, the following day at the latest, unless of course, as will sometimes happen, we're out of stock on your item. When that happens, we order your item immediately via telex or telephone, and when possible, request the factory to ship directly to you to avoid delays. We do all we can to cut any delays to an absolute minimum. When we deliver an item to a customer over the counter, we normally open it and check it for him to be absolutely sure it is right before he leaves. . . we'll do the same thing to your mail order, if you will request it when you order. Some hams do not want the factory-sealed box opened, so we ship that way unless you ask us to check it (and we would prefer to check if you don't object). We have an excellent service department, should you have any problems with new or used gear, and we maintain a good parts stock too. If you wish to purchase your gear on time payments, we accept Bankamericard or Master Charge, or we can finance through General Electric Credit Corporation with 10% down and up to three years to pay. For those who prefer "cash discounts", we do offer them on those lines commonly discounted. Such prices are competitive, but firm. We are in business to make a profit, and know what it takes to stay in business, so we don't try to beat. . . just compete. On "cash" prices, we do not pre-check gear, nor do we offer our store warranty. In other words, we offer competitive service to go with competitive prices. We close on Sunday and Monday to give us time to catch up with our paper work so we can continue to provide the kind of service you want. Our phone is answered automatically 24 hours each day while we're closed and after regular hours so you can call in your order. Phone us at (817) 926-5221. Telex us at 75-8329. Write to the address above. You'll find "southern hospitality", personal service, and a real friendly bunch of hams who sincerely want your business.

Bill Hoisington K1CLL
Far Over Farm
Peterborough NH 03458

THE 1296'er: IDEAL CRYSTAL OSCILLATOR

This details the design of a crystal-controlled oscillator especially designed for 1296 multiplier service, and begins a series on the construction of a complete solid state low-cost rig for 1296 MHz. With transistors that work well in the 2400 MHz band, 1296 should be easy. Well, it isn't all that easy, but with a little care for detail it can be done. A large part of the receiver starting from and including the 28 to 30 MHz tuneable i-f section, through the 1.65 i-f, the 135 kHz i-f, and the audio, all using IC's (integrated circuits) has or will be detailed in articles in 73 Magazine. All you need to complete the receiver is the converter and one or two low noise stages on 1296, and these will be described later on.

We will go into this 1296 in easy stages, with an "Ideal" crystal oscillator first.

Towards An Ideal Crystal Oscillator

This just happens to be the best crystal oscillator I've ever made. Actually it didn't just happen. I worked hard on it. We're going up to 1296 so we need all the "sock" we can get and still have a good, reliable, stable oscillator. This one has the punch – 168 mW rf output at last measurement, it stays right in the pass-band of my lab receiver, comes on the air every time the switch is thrown, and uses the Motorola HEP 55 transistor (only $1.20). This is my Universal Device, which seems to be good for almost any stage anywhere.

This oscillator works with full power on all the crystals I have around in the shack from 45 to 54 MHz, and is the result of over thirty years of working with control crystals. Off and on I should say, and for the last ten years with greater and greater emphasis on transistor units. And the last few days full time to bring you a low-cost excellent design. If it isn't the ideal, it's awfully close!

How It Works

Referring to Fig. 1, NPN Q1 is turned on by supplying positive voltage to the collector and base, causing current to flow. Turn on current and "graininess" in the collector current of L1 is fed back to the base circuit through the control crystal, which reverses the phase (see detail below). Q1 amplifies these minute pulses which in turn resonate in the L1,C1 circuit, and the oscillator takes off, on the crystal frequency only, however. A piezoelectric crystal such as quartz operates by means of compression and extension waves in the crystal. These are also known as sound waves. They are in the form of maximized standing waves which bounce back and forth between two crystal surfaces (outer

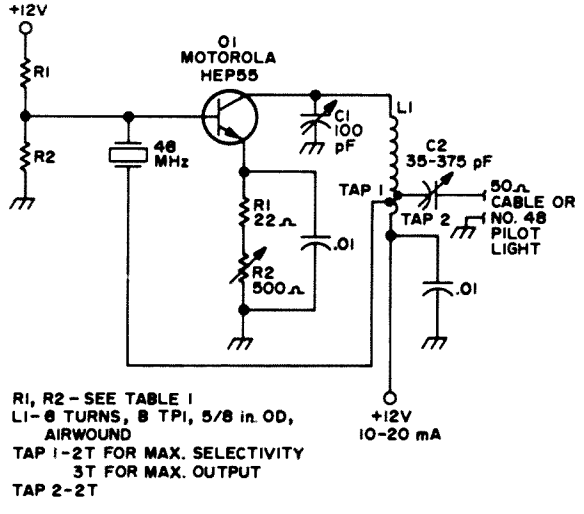


Fig. 1. Ideal crystal oscillator.

wall, or air surfaces) which furnish a high degree of reflection. At one part of the cycle (48 million per second in this case) one side of the crystal is positive and the other negative. The next half cycle, the polarities are reversed under the influence of the ac voltage. Also in this case there is more than one cycle through the cyrstal thickness, but as long as there are an odd number of half waves (sound waves) it will work. This basic action of control crystals thus causes a 180 degree (or nearly that amount) phase reversal from one side to the other, the feedback path from the collector coil L1, which started out *in* phase, reaches the base *out* of phase, which is the proper condition to cause oscillation.

Power can be adjusted by the emitter pot R2, and a fairly good output match can be obtained with tap 2 and C2. Good luck.

Base Bias

This was quite a revelation. I found that almost any combination of R1 and R2 could be used as long as the voltage was right, and this was not critical, except for pushing maximum power out. Table 1 shows representative values for R1 and R2 that resulted from the test runs on this parameter. There appears little difference in power output so you can use any of the values shown. I generally slap in a 5K and a 1K and that's it.

Emitter Bias

This is not in the least critical either. Smooth control of the current and the output rf power is found with R2, varying from 160 mW down to less than 10 mW. And that's it for bias.

Crystals

Using the finished circuit of Fig. 1, four crystals on 48 or 48.1 MHz were tested. A ¾ in. square one was excellent, and three in the small case size ½ in. long by 3/8 in. wide worked just as well with full power out.

Note that the circuit is using quite a lot of feedback, with good output loading also. This can be desirable for multiplier service which we are building here, but if you don't need maximum output you can drop both Tap 1 and Tap 2 down on the coil towards the cold end.

Table I

R1	R2
5K	1K
10K	2K
25K	5K
35K	10K

The Inductance

Several coils were tried in the L1 position, as you may not have some of those air-wound jobs on hand, or you might want to save space and use smaller coils. Coil B gave the same output of 160 mW of rf, the same as coil A, as far as I could determine, which is about plus or minus 5 mW, but did not tune quite as smooth as I would have liked. It had a tendency to jump a little in power as R2 was turned down.

Coil C behaved exactly like coil A, so use C instead of B for smaller size work. The Q of a small size oscillator coil in the maximum load condition is evidently not very different than that of a larger coil.

Feedback tap. This is not too critical, but it should be positioned for the results needed. The ratio of turns from Tap 1 to the cold end, to the number of turns from Tap 1 to the high end is about one to three, as you can see in Fig. 1. This is for maximum output. For maximum selectivity and sharper tuning a slightly larger ratio, with the tap nearer the cold end, is preferable.

Plenty of feedback (lower ratio) is probably best for driving a tripler, which likes a lot of harmonic content.

Output tap No. 2. This is mainly a question of loading and matching, and the series output capacity C2 plays an important part here. A good match to a No. 48 test bulb for milliwatt determination can be obtained with between 50 and 100 pF. For a 50Ω cable, more capacity may be needed.

An excellent crystal controlled oscillator for tripler driving has been described in detail, which should start you off on the way toward an interesting solid state 1296 MHz rig. . . . K1CLL■

Jim Reichler WN2REW
P.O. Box 153
Stony Brook NY 11790

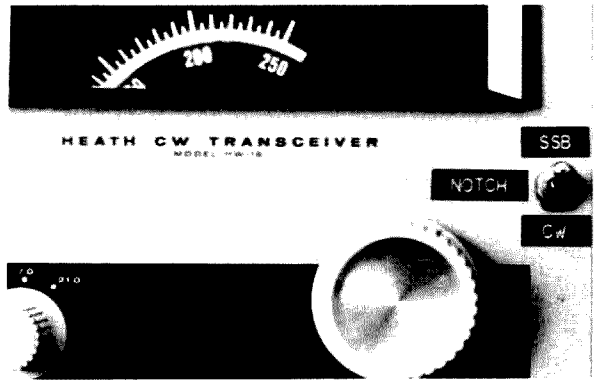
FOR FRUSTRATED NOVICES:

Listening to 'Phone with the HW-16

The Heathkit HW-16 transceiver is a fine, inexpensive rig for CW, and for this reason many Novices use it. Its excellent selectivity (500 Hz) makes copying CW easy and pleasurable.

However, it is a rare Novice who doesn't get bored occasionally with code and would prefer to listen on the phone bands for awhile. It is here that the good selectivity of the HW-16 works against the Novice. The rig's narrow bandspread makes copying SSB or AM nearly impossible.

Since the HW-16 covers a portion of the 40 meter phone band, decreasing the rig's selectivity would allow the Novice operator to listen to the goings-on on this phone band. Happily a simple modification is all that is needed to provide this decrease in selectivity whenever the operator desires it.



The switch can be placed on the rig as shown or in any other convenient location.

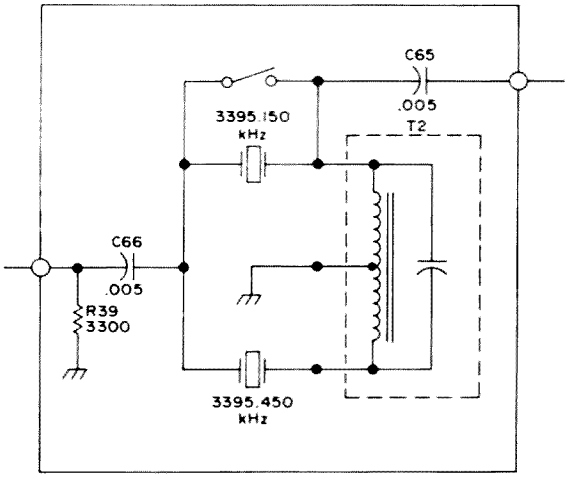
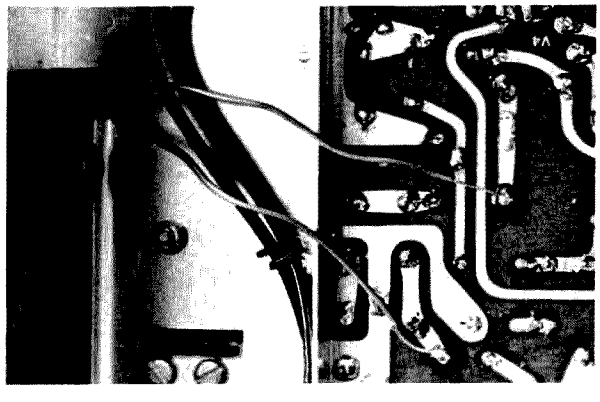


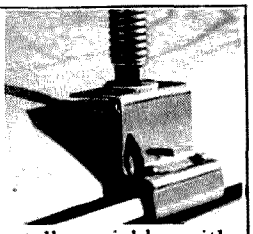
Fig. 1. The new switch runs from C65 to C66, in parallel with the upper crystal.



The lead wires can be soldered to the circuit board and run up to the switch through the opening in the chassis for the tuning dial.

As can be seen in the accompanying schematic (Fig. 1), capacitors C65 and C66

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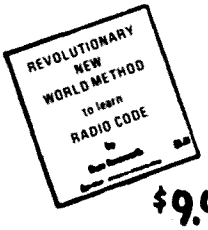
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on the receiver circuit board are connected through an SPST switch. When the switch is closed, this new circuit decreases the effectiveness of the crystal filter enough to allow perfect copy of SSB and AM signals. When the switch is open the original CW selectivity is not affected.

The new switch can be mounted on the front panel of the HW-16 as shown.

There are other uses, "byproducts," of this modification. It can be used in the CW bands to scan a much larger portion of the band than would ordinarily be possible with the rig's normal selectivity. Another possible use is listening to the foreign broadcast stations on 40 meters. And what about a Novice net where all the stations aren't on the same frequency? It's very convenient there, too.

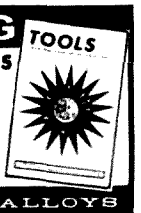
This is just a minor modification, but it can take a deficiency of your HW-16 and change it into versatility, thereby making the rig easier and more enjoyable to own and operate.

My thanks go to Steve (WA2JZJ) for the excellent photographs. . . .WN2REW

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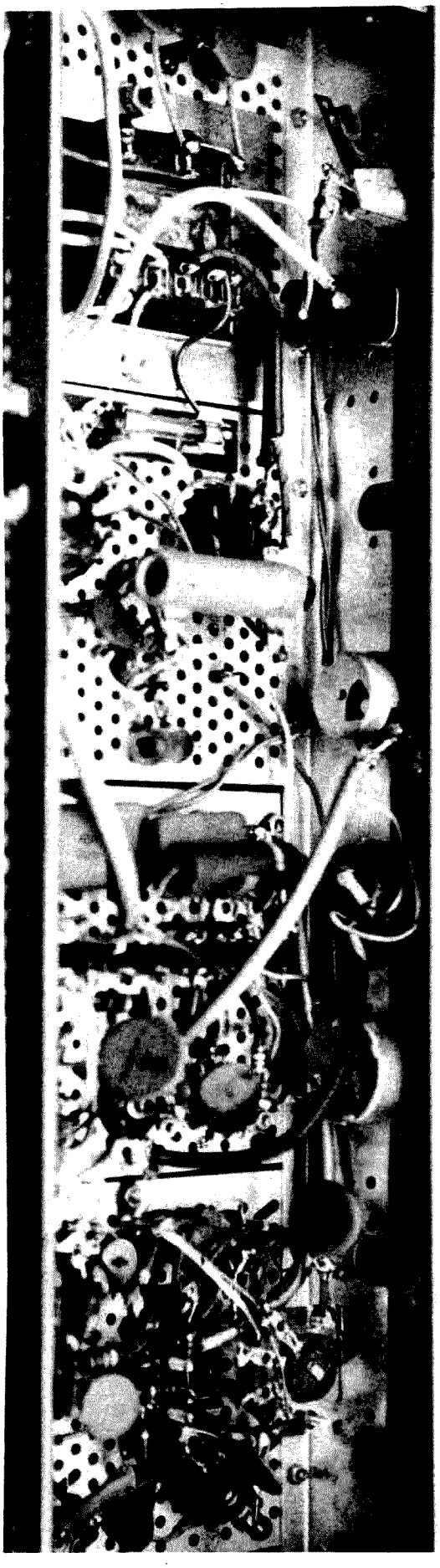
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FM ADAPTER



requency modulation on the 2m band is increasing in popularity. One of the reasons is the availability of surplus FM equipment which can be converted to this use. However, the principal advantages of the FM mode are:

1. Improved signal-to-noise ratio.
2. Freedom from pulse-type interference.
3. Reduction in TVI.

A large percentage of the VHF receiver systems used by amateurs consist of crystal controlled converters ahead of a conventional hf receiver. It is possible to receive FM signals on such a system by detuning slightly so that the center frequency of the FM signal is at the steepest part of the i-f response curve. However, the noise and interference reduction advantages of FM cannot be realized under these conditions.

To realize the full merits of FM reception, an FM adapter can be used with a conventional hf receiver. The adapter to be described operates at an intermediate frequency of 455 kHz with a low impedance input. The latter permits use of coax cable connection to the hf receiver without disrupting the normal operation of the latter.

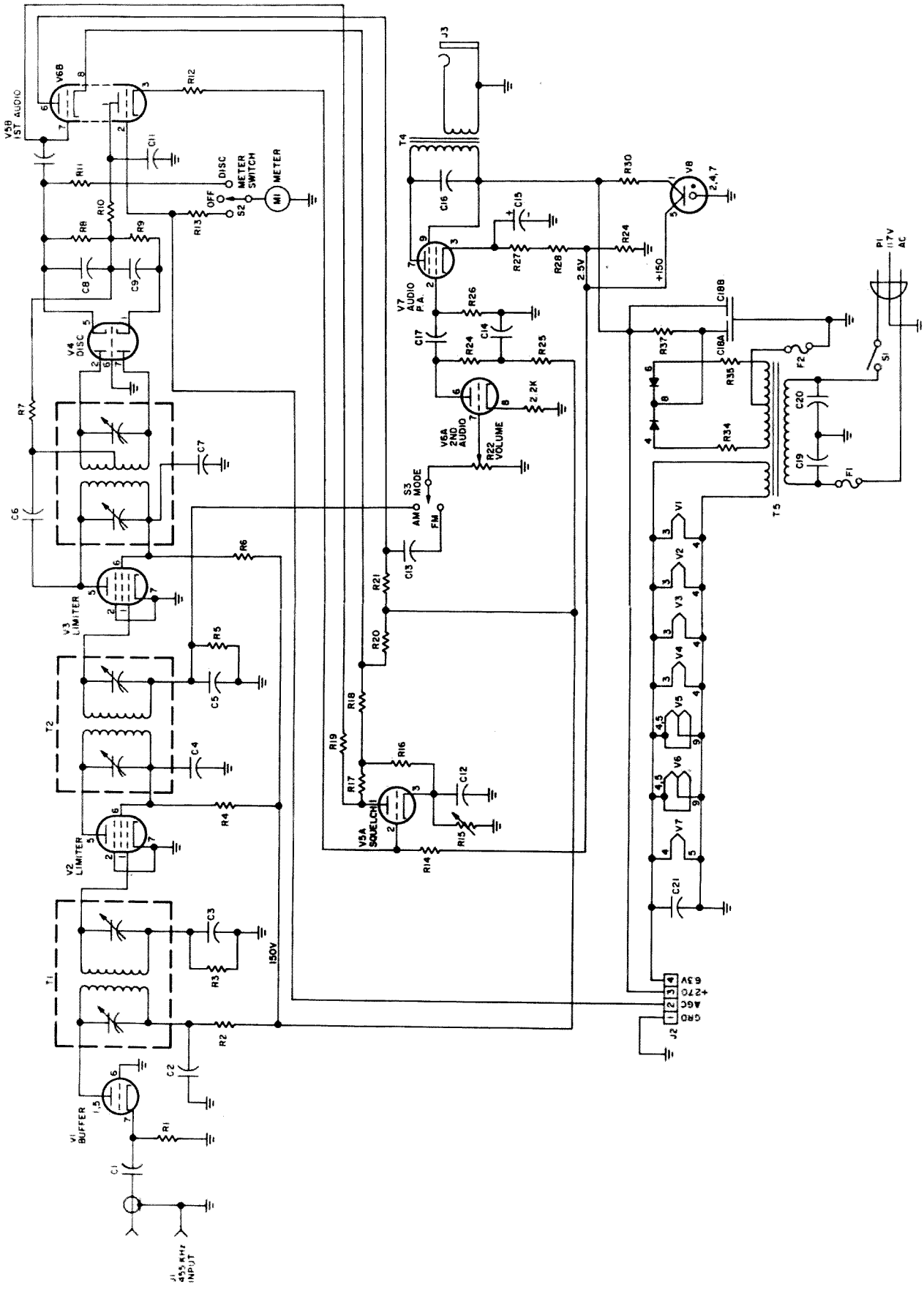

V1 BUFFER
V2 LIMITER
V3 LIMITER
V4 DISC
V5A SQUELCH
V5B 1ST AUDIO
V6A 2ND AUDIO
V7 AUDIO P.A.
V8
J1 455 KHz INPUT
J2
J3
T1
T2
T4
T5
S1
S2 METER SWITCH
S3 MODE
M1 METER
OFF
DISC
AM
FM
150V
2.5V
+150
2.2K
R22 VOLUME
CRO
AGC
+270
6.3V
117V AC

Figure 1 is a schematic diagram of the adapter. Metal work consists of components from the Lektrokit* chassis system. Four 4 x 4¾ in. chassis plates were used as follows:

Plate No. 1 carries the 6C4 buffer amplifier, first i-f transformer, 6AU6 first limiter, second i-f transformer, 6AU6 second limiter, discriminator transformer and 6AL5 discriminator.

Plate No. 2 carries two 5751 tubes, comprising the squelch and first audio section, the 6BQ5 audio power amplifier and the audio power output transformer.

Plate No. 3 holds a plug-in 20/20 μF 450V electrolytic capacitor, a plug-in rectifier assembly, 1N2389, and an OA2 regulator tube.

The fourth plate is taken up by the power transformer.

Fig. 1. Schematic. Parts List: R1, R25 – 1000Ω ½W resistor; R2, R16 – 1500Ω ½W resistor; R3, R14 – 470,000Ω ½W resistor; R4, R23, R32 – 2200Ω ½W resistor; R5, R8, R9, R10, R11, R12, R19, R21, R24 – 1000,000Ω ½W resistor; R6 – 21,000Ω ½W resistor; R7 – 68,000Ω ½W resistor; R13 – 1 MΩ ½W resistor; R15 – 1000Ω 4W variable resistor; R17 – 330,000Ω ½W resistor; R18 – 100Ω ½W resistor; R20 – 15,000Ω ½W resistor; R22 – 500,000Ω potentiometer; R26 – 390,000Ω ½W resistor; R27 – 100Ω 1W resistor; R28, R29, R34, R35 – 51Ω 1W resistor; R30 – 5000Ω 10W resistor; R31 – 1000Ω 10W resistor; R33 – 470,000Ω ½W resistor; C1, C2, C3, C4, C7, C10, C13, C17, C19, C20, C21 – ..01 μF disc ceramic 500V capacitor; C5, C6 – pF mica capacitor; C8, C9 – 200 pF mica capacitor; C11 – .15 μF paper capacitor; C12, C14 – .05 ceramic capacitor 300V; C15 – 25 μF, 25V, electrolytic capacitor; C16 – .003 μF mica capacitor 600V; C18A, C18B – 20 μF, 450V electrolytic capacitor; T1, T2 – 455 kHz interstage transformer. MILLER No. 512C2 or equivalent; T3 – 455 kHz output transformer. MILLER No. 512C3 or equivalent; T4 – 5000Ω primary, 500Ω secondary, audio transformer. STANCOR A3841 or equivalent; T5 – Power transformer. Primary 117V 60 cycle. Secondary #1 520V C.T., Secondary #2 6.3V, 4A. THORDARSON 26R31U or equivalent; S1 – Single pole, single throw toggle switch; S2 – Single pole, 3 position, lever switch; S3 – Single pole, 2 position, rotary switch; CR1 – Plugin, octal base, rectifier tube sutstitute 1N2389 or equivalent; F1 – Fuse, 3A, slo-blo; F2 – Fuse, 1/8A, slo-blo; M1 – Microammeter, zero center, 25-0-25; P1 – Power plug, Grounding type; J1 – BNC RF Receptacle, UG-625/U; J2 – 4-yin socket, Jones S-304-AB or equivalent; J3 – Phone jack.

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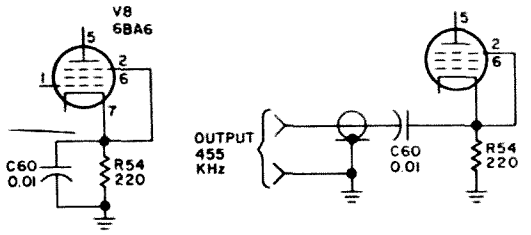


Fig. 2a. Original schematic GPR-90
b. Modified schematic, GPR-90.

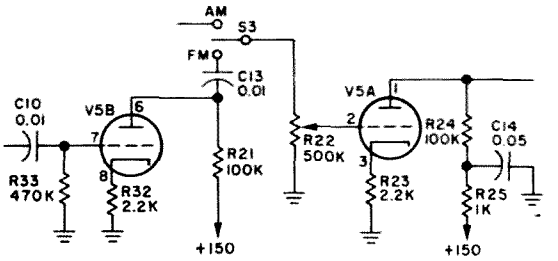


Fig. 3. Audio circuit without squelch.

The i-f input receptacle, J1 the accessory output receptacle, J2, and fuse, F1, are mounted on the rear panel of the chassis assembly. The front panel carries the audio output jack, J3, the power switch, S1, volume control, R22, AM-FM switch, S3, squelch adjust, R15, meter switch, S2, and the tuning meter, M1.

Buffer stage, V1, provides a low impedance input and isolates the first i-f transformer from the influence of external connections. If the hf receiver does not have a low impedance output, one can be provided fairly simply. Figure 2 shows how this was done for a GPR-90 receiver. Figure 2a is a partial schematic of the third i-f stage. Figure 2b shows the change to give a low impedance output; the bypass capacitor for the cathode resistor of the third i-f tube was lifted off ground and taken to an output jack. A shorting plug can be applied to the output jack when the FM adapter is not in use. It should be noted that the bandwidth at the receiver output jack is governed by shorting plug can be applied to the output jack when the FM adapter is not in use. It should be noted that the bandwidth at the receiver output jack is governed by the preceding stages. If wideband response is required, the takeoff should be at an earlier i-f stage (with subsequent loss in gain).

V2 functions as a conventional amplifier-limiter. Its input and output uses conventional 455 kHz i-f transformers. V3 acts as a limiter for FM reception, but is a detector for AM reception. In the latter case, the AM envelope is taken off the grid resistor, R5, for V3.

*A.P.T. Electronics Industries, Ltd., Chersy Road Byfleet, Surrey, England.

A discriminator transformer, T3, was produced by adding the phasing network C6, R7, to a standard full-wave detector transformer. V4 is a Foster-Seely discriminator. It provides the following outputs:

1. Audio signal through coupling capacitor C10.
2. AGC voltage through R10 and J2 to the hf receiver.
3. Squelch voltage through R10, V6B and R12 to the squelch tube, V5A.
4. Tuning indicator voltage through R10 and R13 to the tuning meter, M1.
5. Discriminator voltage through R11 to the tuning meter for tuning or adjustment of T3.

V5B is a squelch-controlled audio amplifier which is used only for FM reception. V6A and V7 form the remainder of the audio system. The cathode resistors for V7, R27, R28 and R29, form a voltage divider to obtain approximately +2.5V delay voltage for the squelch tube, V5A. V6B is used as a diode to isolate this positive voltage.

With no input signal to the adapter, the positive delay voltage appears at the grid of the squelch tube, V5A, causing the tube to draw maximum current. The current flowing through its plate resistor, R17, produces a voltage drop at the grid of the first audio tube, V5B, thus cutting off operation of this tube. For signal conditions, the negative squelch voltage, applied through the diode, V6B, overcomes the positive delay voltage. This cuts off squelch tube, V5A, and the first audio amplifier stage operates at normal gain. The sensitivity of control for V5A is adjusted by R15.

In case it is not desired to incorporate the squelch circuitry, one 5751 tube can be eliminated. The audio schematic would then be as indicated in Fig. 3.

It should be noted that all stages, except the audio power amplifier, operate from a regulated plate voltage of 150. The PA stage has a 500Ω output. A 5000Ω to Voice Coil transformer may be substituted for T3 if desired.

In order to insure compatibility with the hf receiver with which this FM adapter is to be used, it is desirable to use all the receiver during the alignment process.

Set the signal generator for any convenient frequency within the range of the hf receiver and turn on the tone modulation. Tune the receiver for maximum response as indicated on the receiver's S-meter. Set adapter mode switch to FM and the meter switch on TUNE. Adjust T1, T2, and T3 for maximum response on the meter. Throw meter switch to DISC. and adjust the secondary of T3 so that the meter reads zero center. At the same time, monitor the audio output which should decrease in level as the meter needle is centered. Turn off the signal generator and adjust the squelch control, R15, so that the background noise in the output of the FM adapter just fades out. This completes the alignment.

In operation, the meter switch is normally left on TUNE. However, the discriminator adjustment should be checked occasionally by switching the meter to DISC.

This unit should provide quiet, effective reception of FM signals. All parts are readily available and the chassis system makes construction simple.

. . .W1LE

References:

1. Reception of F.M. and P.M. Signals. The Radio Amateur's Handbook, ARRL, Forty-sixth Edition. Pages 128–129.
2. Reception of FM Signals. The Radio Handbook. Editors and Engineers, Ltd. Seventeenth Edition. Pages 319–324.
3. F.M. Reception. R.S.G.B. Amateur Radio Handbook, Third Edition. Pages 338–341.
4. Frequency Modulation. John F. Rider Publisher, Inc.
5. Frequency Modulation. August Hund. McGraw–Hill Book Co., Inc. First Edition. Chapter IV.
6. Radiotron Designers Handbook. F. Langford-Smith. Fourth Edition. Pages 1088–1105, 1149–1150.
7. Handbook Preferred Circuits, NAVWEPS 16-1-519, National Bureau of Standards. Pages 60–2, 60–3, 64–2, 64–3.

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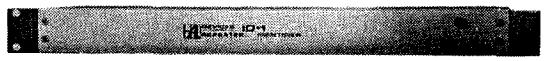
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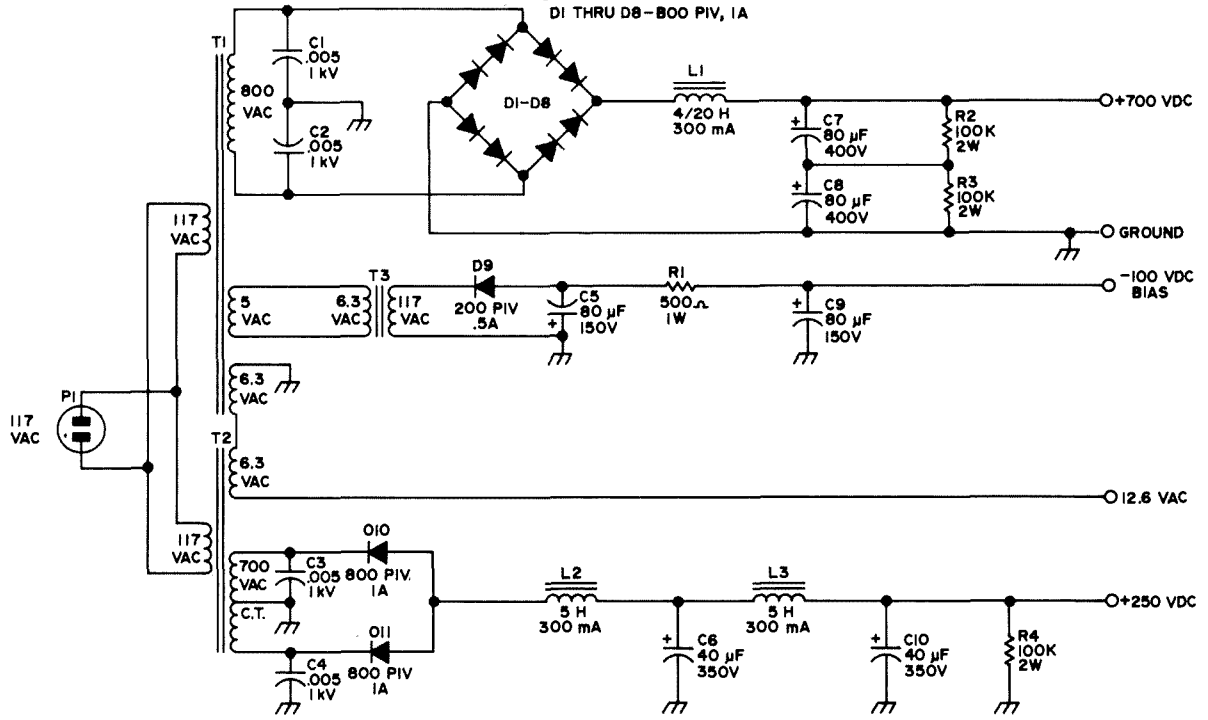


Fig. 1. Power supply.

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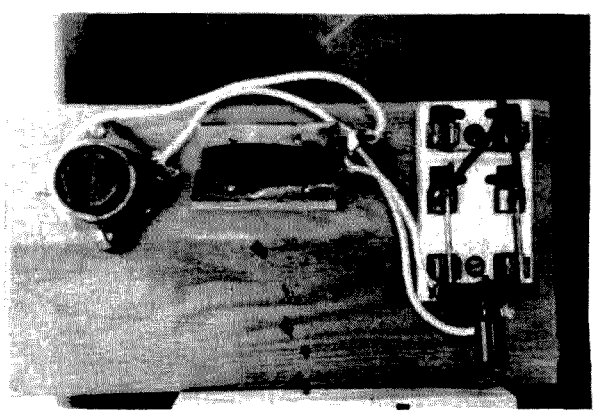
Here is a practical, useful little gadget that is easily constructed, and is so simple, it is ideal for a first construction project for a Novice. Just a simple timer that will turn a rig on automatically so when your sked time arrives, the rig will be all warmed up and help avoid undesirable frequency drift.

The heart of this timer is a cheap alarm clock. One that, when the alarm goes off, a key on the back of the clock turns or unwinds. My clock cost $1.98 and has worked perfectly now for four years. When the key turns, it drops off a shorting piece of metal, closing the ac circuit, as explained below.

The base board may be of any material. Mine is just a small board, 5 x 7 in. Its size, and the arrangement of parts, is not critical. If you wish you may rig a dust-cover, using a cardboard box painted with black paint.

You will need these parts: clock, ac plug and cord to reach from timer to electric outlet supplying current to your rig, DPST switch to open the ac line, socket to plug your rig into and a fuse holder and fuse, if you wish one. The switch that does the turn-on job is made from 2 lengths of ¼ round wood, about 3 in. or so long. You will need a few square inches of copper foil to cover the ¼ round wood pieces.

Glue a brad about 3/8 in. or so long onto the key on the back of your clock. Use



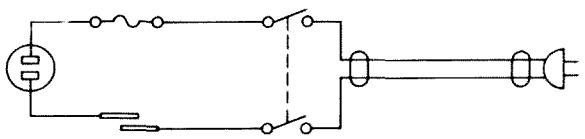


Fig. 1. Timer. Parts: 1. Socket to plug transmitter into. 2. Fuse – any kind is OK. 3. Switch – 2 pieces of ¼ round, copper covered. 4. DPST switch. 5. Cord long enough to plug into electrical outlet. 6. Plug.

epoxy glue, and it will hold for years. Cut a brass or copper disc or square piece of stock about 5/8 in. or so, round or square, and drill a small hole in it toward one side, to fit easily over the brad on the clock key.

Cover the two pieces of ¼ round with copper foil and connect a wire to each and fasten the ¼ rounds to the base, very close together. The distance apart is such that when the metal piece drops on the two ¼ round pieces, it closes the circuit across the two pieces. Leave room for your clock to sit on the base, directly in front of the ¼ round "switch."

Set the alarm on the clock for the desired turn-on time; put the piece of metal on the brad on the clock key, and set the clock on the base so that the brad is up above the ¼ round "switch." When the alarm sounds, the key will turn, dropping the metal piece off the brad and letting it fall onto the "switch," closing the circuit. That's it!

I leave the rig switch on, and turn the rig off by opening the DPST switch, which takes all current off everything so you can pick up the metal piece and have it ready for the next time. Be sure to use a double pole switch so that both sides of the ac line are entirely cut off. If your junkbox won't provide a DPST switch, you can buy one at a very low price.

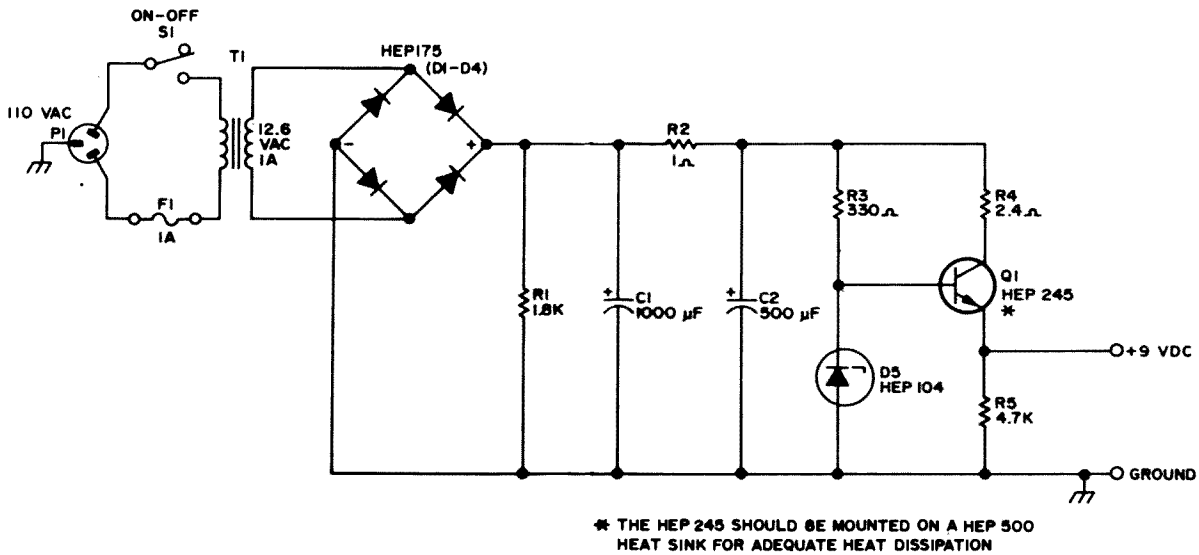
My timer uses a DPDT switch with one pair of contacts not used – just because I had this switch in the junkbox.

. . .W6LM

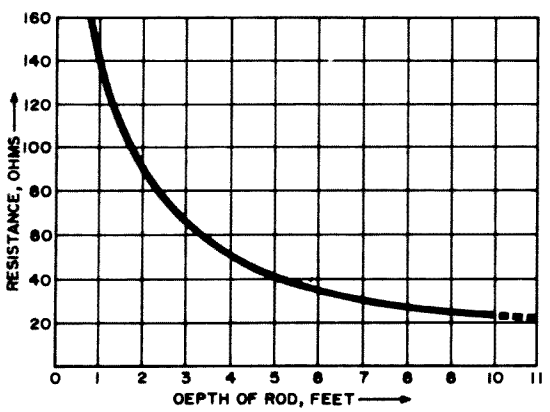
CIRCUITS, CIRCUITS, CIRCUITS...

The following circuits have appeared in the referenced books, magazines, application notes, etc. While we try to reproduce all of the information that should be needed by an experienced constructor, readers may want to avail themselves of the original sources for peace of mind.

Readers are requested to pass along any interesting circuits that they discover in sources other than U.S. ham magazines. Circuits should be oriented toward amateur radio and experimentation rather than industrial or computer technology. Submit circuit with all parts values on it, a very brief explanation of the circuit and any additional parts information required, give the source and a note of permission to reprint from the copyright holder, if any, and the reward for a published circuit will be a choice of a 73 book. Send your circuits to 73 Circuits Page, 73 Magazine, Peterborough NH 03458.

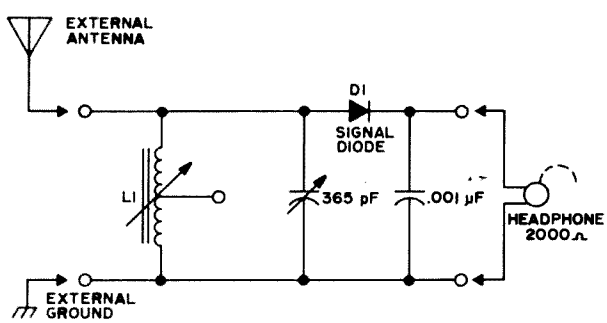


Simple power supply. Circuit courtesy of Motorola Construction Projects.

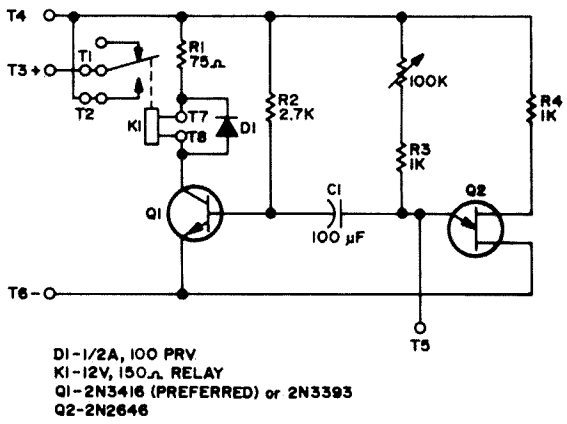


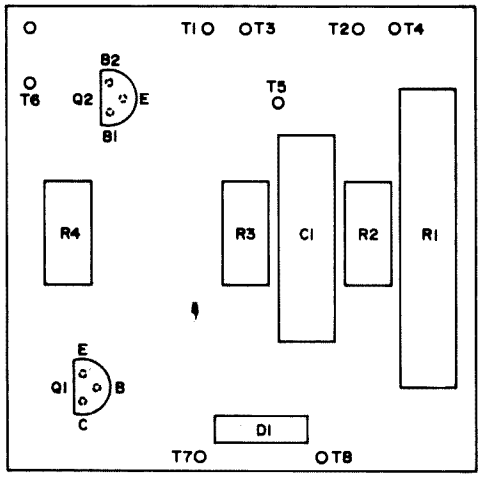
EARTH RESISTANCE DECREASES WITH OEPTH OF ELECTROOE IN EARTH.

When you find that your earth-electrode resistance is not low enough, there are several ways you can improve it: 1) Lengthen the earth electrode in the earth; 2) Use multiple rods; 3) Treat the soil. As you might suspect, driving a longer rod deeper into the earth, materially decreases its resistance. In general, doubling the rod length reduces resistance by about 40%. *The curve at left shows this effect. For example, note that a rod driven two feet down has a resistance of 88Ω; the same rod driven 4 feet down has a resistance of about 50Ω. Using the 40% reduction rule, 88 X 0.4 = 35Ω reduction. A 4-foot deep rod, by this calculation would have a resistance of 88–35 or 53Ω – comparing closely with the curve values.*

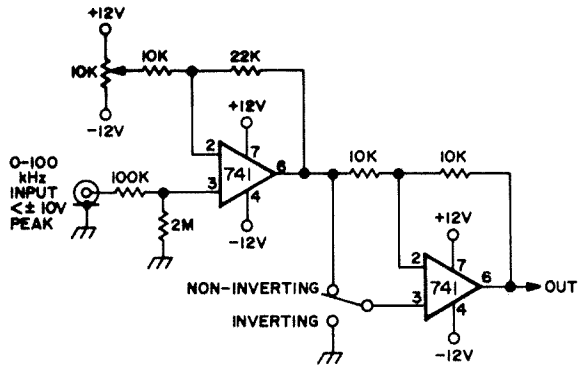


Crystal diode receiver, the simplest radio possible, runs forever without batteries. Signal diode is Calectro K4-550. Circuit courtesy of GC's Calectro·Handbook.

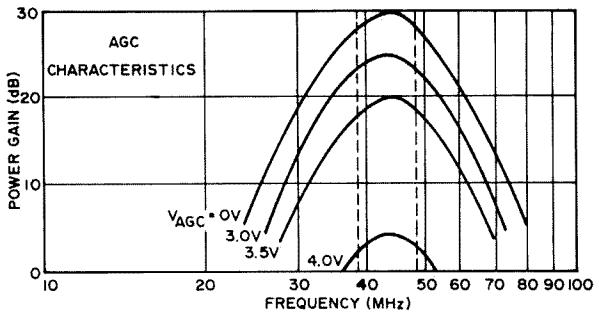


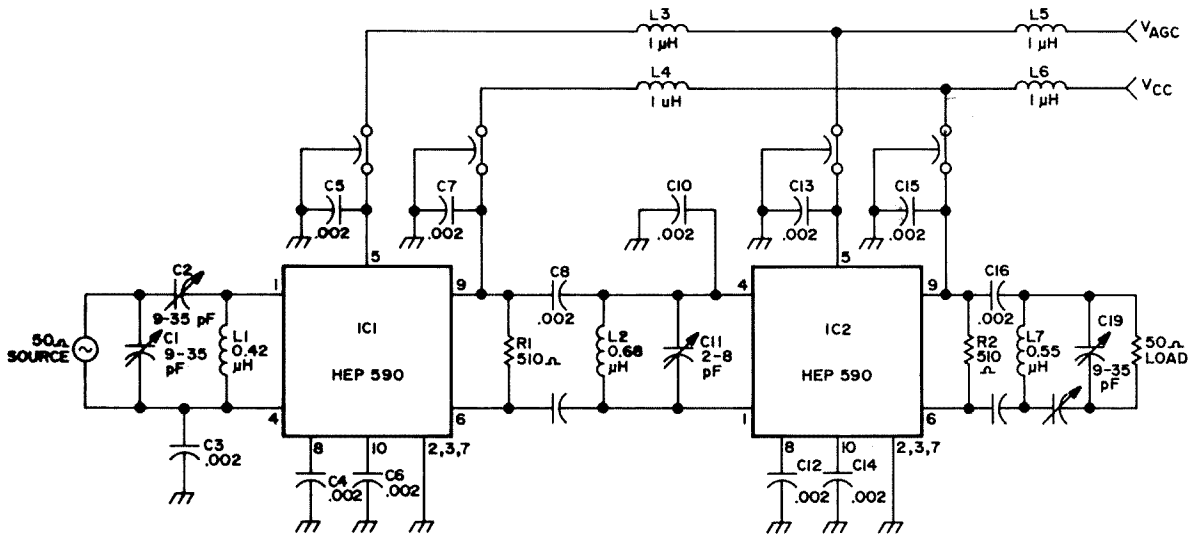


Timer board, adjustable 0 ~ 20 seconds. R1 – 12V, 150Ω relay; D1 – ½ amp, 100V; Q1 – 2N3416 (preferred) or 2N3393; Q2 – 2N2646 (K6AEH).

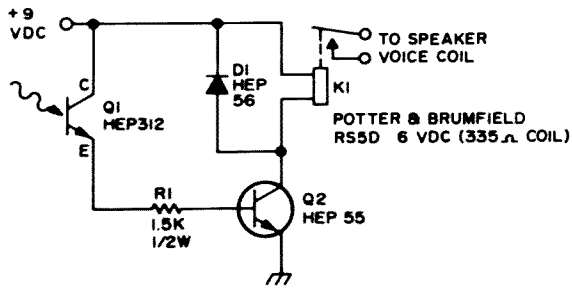


Low speed counter, scope or audio dc input level and polarity switcher. This circuit will change the level of the input signal by means of the pot. The polarity (rise and fall) may be inverted by means of the switch. (Thanks to WØLMD)

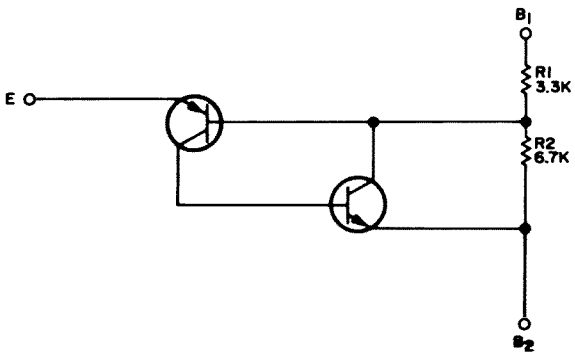




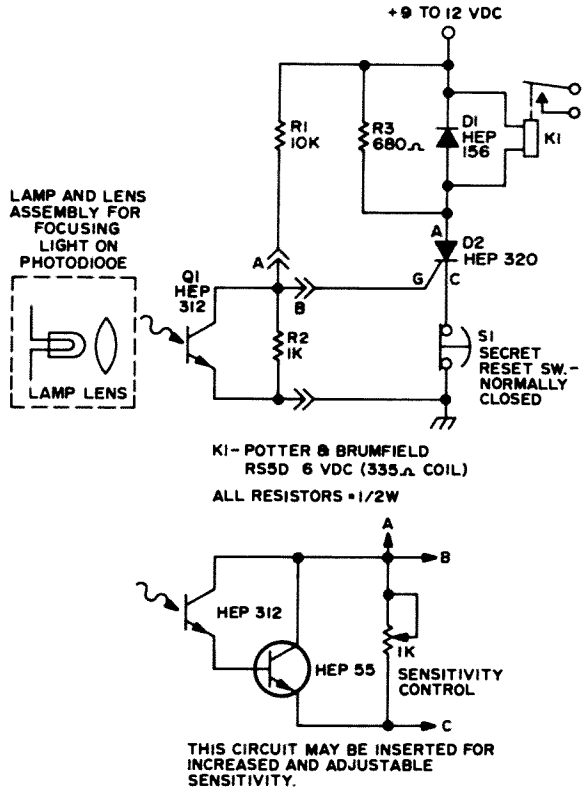
Wide band 45 MHz amplifier, with chart showing AGC characteristics. Circuit courtesy of Motorola.



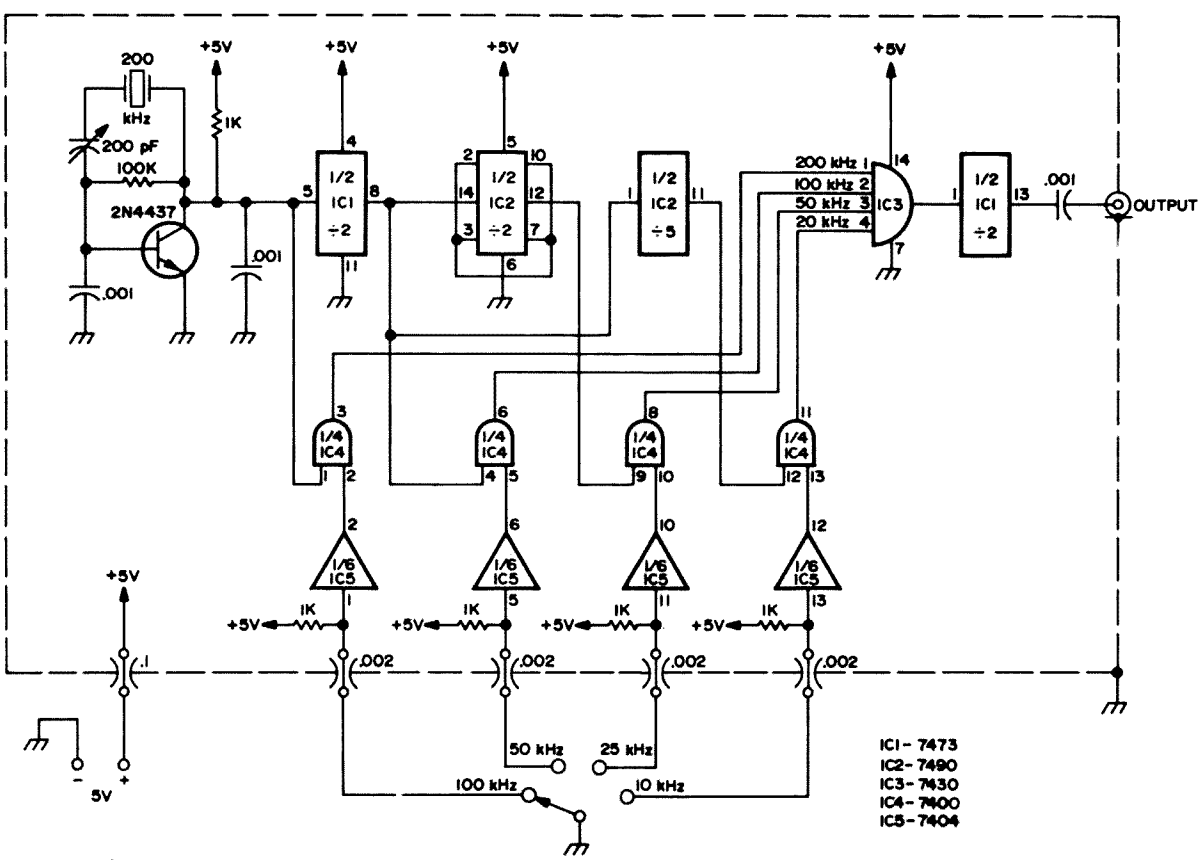
T.V. commercial killer, with no interconnecting wires. Use a flashlight to key relay. Circuit features low battery drain, auto reset. Courtesy Motorola construction projects.



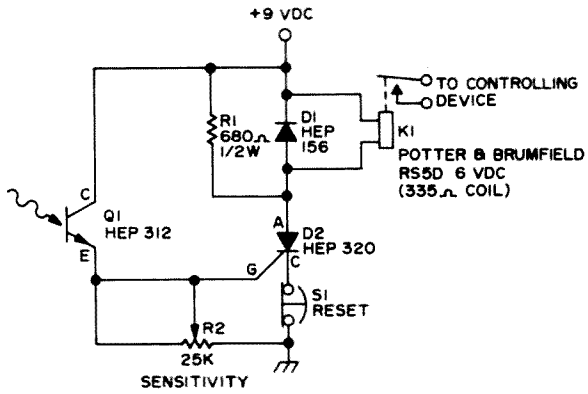
2 transistor – 2 resistor equivalent of a programmable unijunction transistor (credit WB2VKU).



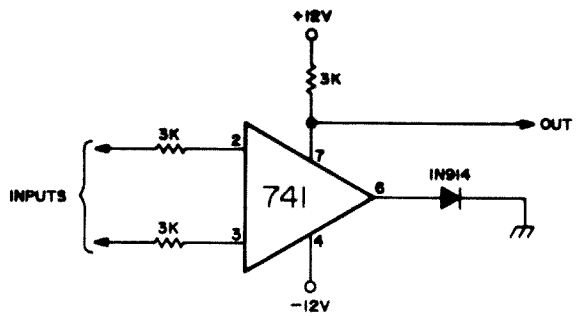
Burglar alarm (photoelectric) will actuate alarm when light beam is broken. Courtesy Motorola construction projects.



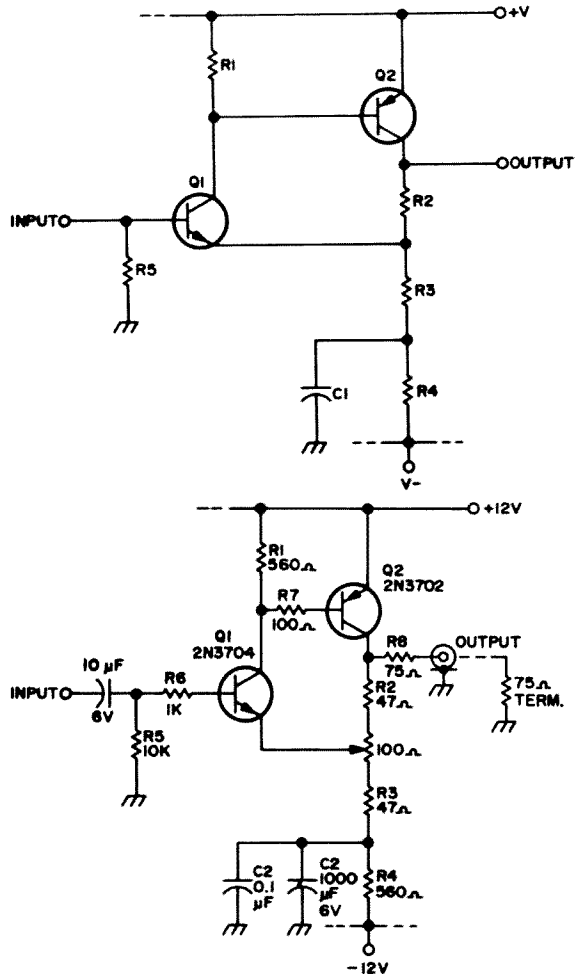
Crystal calibrator. This circuit gives symmetrical square waves out on 100, 50, 25 & 10 kHz. The frequency switch may be any distance from the totally shielded calibrator, as the lines have only dc levels. (Thanks to WØLMD)



Headlight operated garage door or light switch. Relay contact will close when light hits photodiode. Sensitivity adjustment is provided to prevent false triggering. Circuit courtesy of Motorola construction projects.



741 used as a high speed comparator. The output of this circuit varies from +12 to +2 volts and back with extremely fast rise and fall times. (Thanks to WØLMD)

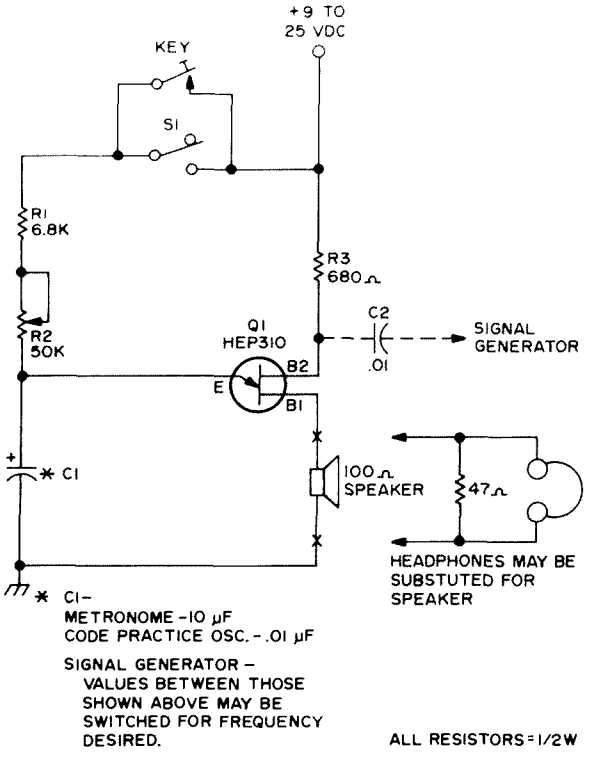


Two transistor video amplifier, medium input impedance (5K) and low output impedance. Almost any small signal HF transistors will work in the circuit but ideally they should have a high cut-off frequency, reasonably high current gain and low output capacitance. In deciding on circuit values, the value of R3 should lie between about 22Ω and 100Ω and the value of R2 chosen to suit the gain required. Courtesy, Journal of BATC.

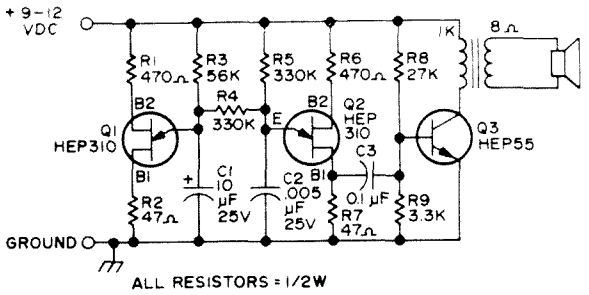
Power Watts	1.6–3.5 MHz	28–29.7 MHz	35–36 42–44 50–54 MHz	144 – 148 150.8 – 161.6 MHz	450–460 MHz
10	40	100	40	15	10
50	90	220	90	35	20
100	125	360	130	50	30
180	—	—	—	65	40
250	200	490	205	75	45
500	—	—	290	—	—
600	300	760	315	115	70
1,000	400	980	410	150	90
10,000	1,250	—	1,300	—	—

Recommended safe distances, in feet, from blasting sites for mobile transmitters.

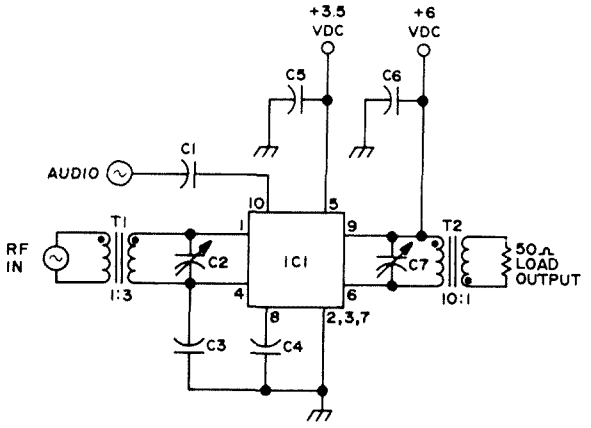
Reprinted from the British Columbia FM Comm. Assn.



Metronome or code practice oscillator and audio generator.



Siren oscillator with an attention getting rising and wailing output. Use with burglar alarm, for instance.

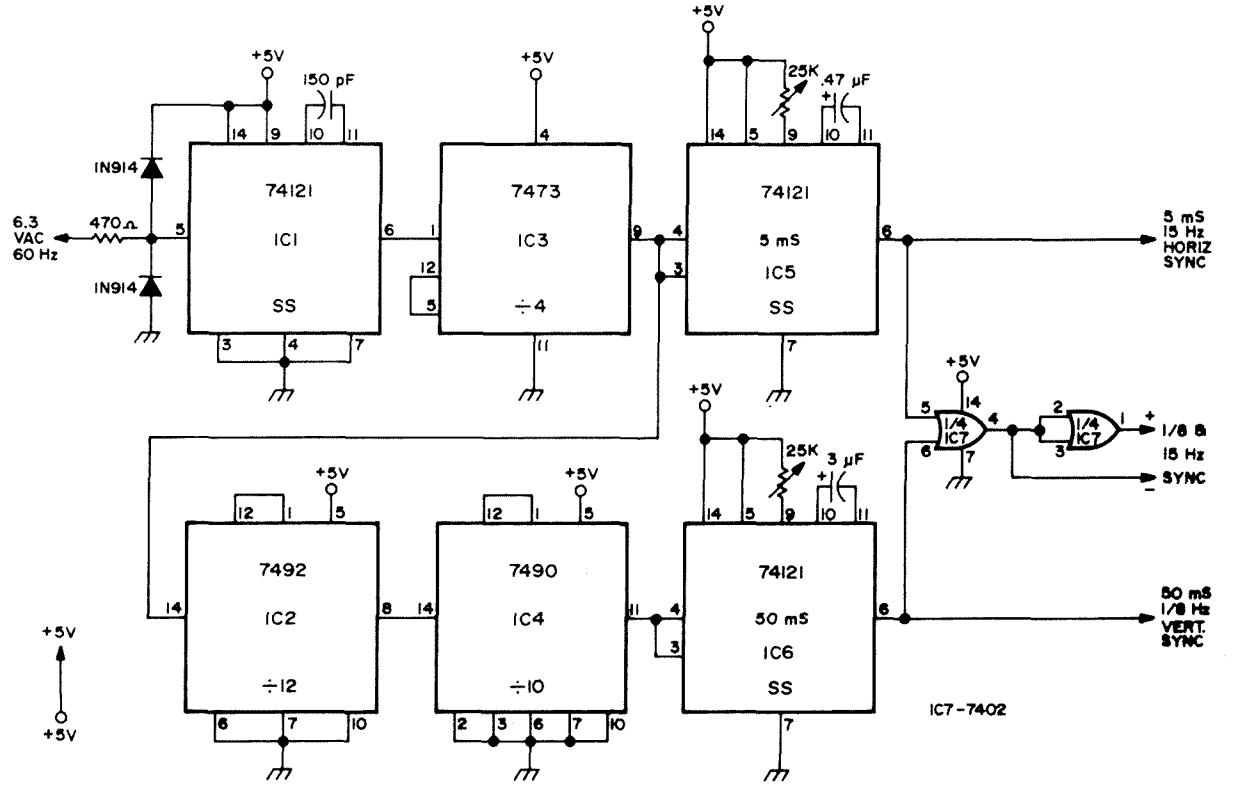


IC1 – HEP 590
C1 – 1 μF
C2, C3 – 0.47 μF
C4, C7 – 0.1 μF
C5, C6 – 1.5 TO 10 pF
(TUNE TO 52.25 MHz)

T1 – 6:18 TURNS NO. 32 AWG WIRE ON MICROMETAL T-12-2 CORE.

T2 – 28:3 TURNS NO. 36 AWG WIRE ON MICROMETAL T-12-2 CORE.

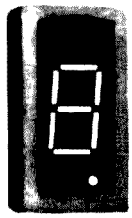
6 meter AM modulator using a Motorola HEP590.



SSTV frequency standard. This simple circuit provides the needed pulses for slow scan TV cameras, flying spot scanners, and pattern generators (thanks to WØLMD).

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3.5 W AUDIO AMP IC
HI-FI QUALITY
$3.95
with 12 pages of construction data

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NATIONAL DEVICES

LM370	AGC/Squelch amp	$4.85
LM373	AM/FM/SSB strip	$4.85
LM309K	5V 1A regulator. If you are using TTL you need this one.	$3.00

POPULAR IC's

MC1550	Motorola RF amp	$1.80
CA3020	RCA ½ W audio	$3.07
CA3020A	RCA 1 audio	$3.92
CA3028A	RCA RF amp	$1.77
CA3001	RCA	$6.66
MC1306P	Motorola ½ W audio	$1.10
MC1350P	High gain RF amp/IF amp	$1.15
MC1357P	FM IF amp Quadrature det	$2.25
MC1496	Hard to find Bal. Mod.	$3.25
MFC9020	Motorola 2-Watt audio	$2.50
MFC4010	Multi-purpose wide band amp	$1.25
MFC8040	Low noise preamp	$1.50
MC1303P	Dual Stereo preamp	$2.75
MC1304P	FM multiplexer stereo demod	$4.95

FETs

MPF102	JFET	$.60
MPF105/2N5459	JFET	$.96
MPF107/2N5486	JFET VHF/UHF	$1.26
MPF121	Low-cost dual gate VHF RF	$.85
MFE3007	Dual-gate	$1.98
40673	Dual-gate	$1.75
3N140	Dual-gate	$1.95
3N141	Dual-gate	$1.85

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9582 Multi-function gate & amplifier ... $3.15
95H90 300 MHz decade counter $16.00
A 95H90 & 9582 makes an excellent prescaler to extend low frequency counters to VHF – or use two 9528s for a 160 MHz prescaler.

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N5111A	FM/IF Demodulator	$1.50
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KW Balun kit only	$3.50
T68-2 3 cores	$1.00
T50-2 3 cores	$1.00
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Ferrite Beads 1 doz. $1.00

MOTOROLA TUNING DIODES

Silicon voltage variable capacitance diodes in TO-92 plastic case like plastic transistors. Both standard Motorola and HEP numbers are listed; devices are same. Capacitance value is typical at –4Vdc. Tuning ratio is approx. 3:1.

MV2101/R2500 6.8	pF	$1.10
MV2103/R2501 10	pF	$1.10
MV2105/R2502 15	pF	$1.10
MV2109/R2503 33	pF	$1.10
MV2112/R2504 56	pF	$1.10
MV2115/R2505 100	pF	$1.10

FAIRCHILD RTL DIGITAL IC's

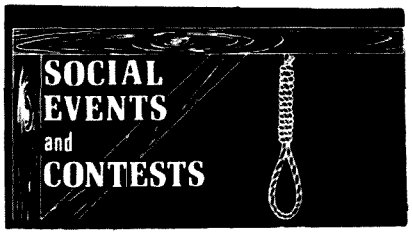
UL900 Buffer	.80
UL914 Dual 2-input Gate	.80
UL923 JK flip-flop	$1.50

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WORKED OHIO'S HIGHEST POINT AWARD

Sponsored by the Champaign–Logan County Amateur Radio Club. Will be issued for contacts made during field day and one of the VHF contests with the club station W8EBG; operating at Ohio's highest point located in Bellefontaine, Ohio. Only contacts made after June 1, 1972 will count. Send $1.00 or seven IRCs to cover cost of handling and mailing to: John L. Wentz, Box 102, West Liberty, Ohio 43357.

RADIO CLUB OF TACOMA HAM-FAIR will be August 19th and 20th at the Sportsmen's Chateau, 164th and Canyon Road, south of Tacoma. Activities will include contests, transmitter hunts, technical talks and displays, manufacturer's displays, auction, country store, beauty contest, and door prizes. Grand prize will be a solid-state 2 meter transceiver. Talk-in frequencies – 146.76 and 3965. Camping–$1.50 per night with electrical hookup. Advance registration will cost $5.00 and includes Saturday evening dinner, or $3.00 without dinner. Contact Emil Koth, K7GPK, 13616 10th Ave. East, Tacoma, Washington 98445, for registration forms or motel information.

ROCKFORD AMATEUR RADIO ASS'N The Bel-Rock Hamfest will be held August 20 at the Boone County Fairgrounds just north of Belvidere, Illinois on highway 76. Free coffee and donuts from 9:30 to 10:00 AM. There is no set-up fee and plenty of free parking is available. Talk-in on 146.94 MHz. Advance tickets are $1.00, $1.50 at the gate. For further information, contact: Lee Gehlausen, WA9WVY, 4610 Cayuga, Rockford, IL 61107.

SWAPFEST & PICNIC Sunday August 13, at the City Park in Levelland, Texas. Sponsored by the Northwest Texas Emergency Net and the Hockley County Amateur Radio Club. This event is for the entire family. Bring your own picnic basket. Free registration begins at 0900. Lunch at 1300. Swapping all day. Mobile talk-in frequency is the Net Frequency of 3950 kHz & 146.28–88, the Levelland Repeater (WB5EMR) or 146.34–94, through the Lubbock repeater.

7TH. ANNUAL MELBOURNE HAMFEST sponsored by the Platinum Coast A.R.S., will be held September 16th and 17th at the Melbourne Florida Civic Auditorium. Hours: 9 AM – 4 PM. Bring your gear to sell or trade. Plenty of paved parking. Registration $1.50 for each adult. Children free. For more information write Donald E. Sanders W4BWS, 1422 Virginia Drive, Melbourne, Florida 32935.

The annual Iowa 75 meter phone net will be held on the third Sunday in August, August 20, 1972, at Riverview Park in Marshalltown, Iowa. All amateurs and their families are cordially invited, or anyone interested in amateur radio. Each should bring a covered dish and his own service. Festivities will begin around noon. Prizes will be offered and a swap table will be available.

PRAIRIE DOG AMATEUR RADIO CLUB of South Dakota will hold its Summer 1972 picnic August 19th and 20th at the Isaac Walton League Club House on Lewis & Clark Lake west of Yankton, South Dakota. The festivities will begin at 1:00 PM Saturday with a talk-in on 3955 KHz and 146.94 MHz. There will be swap tables and a social get-together, transmitter hunt, films, tours of Electronics manufacturing plants and the Gavins Point Dam. Special interest sessions, programs for the ladies, bingo, and nearby swimming facilities promise to make this the event of the year. To pre-register, send $4.00 to P.D.A.R.C., PO Box 321, Yankton, South Dakota 57078.

The Shenandoah Valley Amateur Radio Club will hold their annual Hamfest in Winchester, Va. the weekend of August 5th and 6th.

A kick off Dinner will be held Saturday night, tickets $5.00 each. The Hamfest will begin Sunday at 10:00 AM at the Winchester National Guard Armory admission free. Registration for door prizes $1.00 each (no limit). For further information write for flier.

Shenandoah Valley Amateur Radio Club Inc. PO Box 139, Winchester, VA 22601.

The fourth annual Danville Hamfest will be held September 3 at Douglas Park. 146.94 will be monitored along with the Danville 22/82 and the Champaign–Danville 34/76 machines for talk-in traffic. $1 advance registration and $1.50 at the gate. For further information write Alan Woodrum WA9IAC, 1615 N. Bowman, Danville IL 61832.

The Zero-Beaters Annual Hamfest will be held Sunday, August 6, 1972 in the City Park at Washington Mo. Door prizes, free ham gear auction, free bingo for the ladies. Cake walk, free candy scramble for the kids.

The HAMFESTERS 38th Hamfest and Picnic will be held on Sunday, August 13, at the Santa Fe Park, Willow Springs, IL, southwest of Chicago. Exhibits for OM's and XYL's, famous swappers row. For information and tickets write to Joseph W. Poradyla, WA9IWU, 5701 S. California Ave. Chicago, IL 60629.

The Texas VHF-FM Society will hold its annual summer convention August 11, 12, and 13 at the Villa Capri Motor Hotel in Austin, Texas. Technical sessions, manufacturers' displays, door prizes, ladies activities. Call-In will be through the Austin 34-94 repeater. For more information write Gene Chapline, K5YFL, 2206 La Casa, Austin, TX 78704 or Larry Higgins, W5QMU, 2522 Old Hickory Trail, San Antonio, TX 78230.

The Burlington Amateur Radio Club, Inc, Burlington, Vermont, will sponsor the *1972 INTERNATIONAL FIELD DAY* at the Old Lantern, Charlotte, Vermont, on Sunday August 13, 1972.

Outstanding features include the Flea Market, Contests, Demonstrations, special events for the Ladies and the Rock Crowd. Refreshments available all day, excellent camping facilities on grounds, Saturday Nite Happy Hour from 6 to 12 PM. Come a few days early – talk in on 34-94, 22-82, 16-76, 28-88, all mountain-top machines (natch).

Registration $3.50 at the gate, $3.00 early bird. Write to: Al Snow, K1SLU, 12 Duchess Ave. S. Burlington, Vermont 05401. For more information contact IFD chairman Bob Hall, W1DQO, General Green Rd Shelburne, Vermont 05482. Phone (802) 985 – 2235.

On the 23rd and 24th of September, 1972, the North West Amateur Radio Conference is being held at the University of Lancaster, and they would like to extend a warm welcome to any American amateurs who will be in Britain at that time to attend the conference. Any interested amateur may write to Mr. Philip Jones, Department of Environmental Sciences, The University, Bailrigg, Lancaster, England.

BRAND NEW FREQ-SHIFT TTY MONITOR:
NAVY OCT-3: FM Receiver type, freq. range 1 to 26 MHz in 4 bands, cont. tuning. Crystal calib. Reads up to 1500 Hz deviation on built-in VTVM. Cost $1100.00 each! In original box, with instruct. book & cord, fob Mariposa, Cal. Min. signal needed: 15 mv. Shpg wt 110 lbs 49.50

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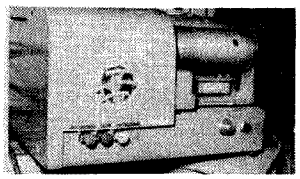
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W2NSD *(continued from page 70)*

tution and by-laws finally were mailed to the repeater groups. There is no hint yet as to how many groups will join the Association. The by-laws leave out more than they include, so some groups feel that in joining they are signing a blank check. No proposal has been made of expenses or goals for the NRA. When questioned about what the NRA could do for the repeater groups, the answer from Bob Waters was, "Don't ask what the Association can do for your group, just what your group can do for the Association." Some groups may want more than mere slogans to justify sending hard earned cash to Waters and Pugh in exchange for unstated goals and benefits.

The sudden resignation of Gary Hendrickson W3DTN, a highly respected Philadelphia FMer, as Secretary of the NRA immediately after the April meeting has not increased overall confidence in the Association.

. . .Wayne

W7DXX *(continued from page 160)*

all the reps of the manufacturers for a very good "Kass-vention." We'll see you there next year.

With both the Editor and Managing Editor of 73 avid DXers we decided to update the 73 hamshack. So, we replaced the Galaxy V, which has given years of faithful service, with the Kenwood Twins from Henry Radio. The trusty 3 element 20 meter beam, the one with the driven element 40 degrees off horizontal since the last snow storm, is being replaced by a 7 element 20 meter beam from Wilson Electronics. We have two other stations under construction. One is a Signal One CX7-A transceiver and the Alpha 70 amplifier. The other is our VHF station for 6 meters through 450. We will be using the Kenwood Twins for SSB and SSTV while the Signal One pair will be used for serious DXing both on SSB and CW. Other antennas include 7 elements on 15, 6 elements on 10, and a 4 element quad up 100 feet. The only problem we are going to have is putting out the magazine with all that new equipment to use.

I want to remind you again about the 73 DXpedition to Bajo Nuevo in November. We need a few more operators. If you can dig the idea of a DXpedition to a remote island, give me a call now. The cost will be around $500 per person. Also, the idea of DX is catching on. So, if your group has not written and called for information, do so now.

. . .W7DXX/1

William P. Turner WAØABI
5 Chestnut Court
Saint Peters MO 63376

GDO COIL EXTENSION

A grid dipper is a great piece of test equipment and belongs wherever rf equipment is to be designed, constructed, or serviced. All writings on the subject seem to be prefaced with this comment, and I hesitate to break tradition. Now that the formalities are over, we will proceed with the subject matter.

Probably the one most inconvenient feature of all grid dip meters is the physical size of the instrument. This holds true for the two unit commercial models as well as the more common self-contained types. It is not so much that they are large but rather that the head will not always fit into the nooks and crannies which seem to be designed into most equipment. This situation will more than likely become more severe as integrated circuits come into more general use. At lower frequencies the coil assembly is usually long enough to reach to within shouting distance of the desired circuit, but as the frequency is increased the dipper coil shrinks to perhaps an inch protruding from the case. Try getting this even near a circuit buried 2 or 3 in. deep in a chassis and you will fully appreciate the magnitude of the problem.

There is a way of relieving the difficulty which requires neither a great deal of time nor expense. It is only necessary to put to use some basic theory which each of us was required to know in order to get a ham license. Required are perhaps a 3 ft length of small coax (RG 174/U), 6 in. of hookup wire and a ballpoint pen casing. The innards of the pen are removed, and the business end reamed slightly to accept the ends of a ½ in. diameter one turn link formed of hookup wire. Inside the barrel of the pen the ends are soldered to the coax, insulated, and cemented in place. The remaining wire is formed into a 2 turn link which fits snugly on the coil form of your grid dipper. This link is soldered to the opposite end of the coax and secured. Shrinkable tubing is perfect to cover the joint.

The next time you face this perplexing problem hold your head high and fear not. Merely slip the link over the coil form, place your probe so as to allow coupling into the desired circuit and proceed as usual. The only difference will be a more or less fixed load on the oscillator which doesn't affect its ability to indicate resonance. As always, best results are obtained with minimum coupling.

. . .WAØABI

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7408	.32	.30	.29	.27	.26	.24	7490	.80	.76	.72	.68	.64	.60
7409	.32	.30	.29	.27	.26	.24	7491	1.43	1.35	1.28	1.20	1.13	1.05
7410	.26	.25	.23	.22	.21	.20	7492	.80	.76	.72	.68	.64	.60
7411	.28	.27	.25	.24	.22	.21	7493	.80	.76	.72	.68	.64	.60
7413	.58	.55	.52	.49	.46	.44	7494	1.18	1.12	1.05	.99	.93	.87
7416	.52	.50	.47	.44	.42	.39	7495	1.18	1.12	1.05	.99	.93	.87
7417	.52	.50	.47	.44	.42	.39	7496	1.18	1.12	1.05	.99	.93	.87
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7423	.80	.76	.72	.68	.64	.60	74121	.56	.53	.50	.48	.45	.42
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7437	.56	.53	.50	.48	.45	.42	74145	1.41	1.33	1.26	1.18	1.11	1.04
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7445	1.71	1.62	1.53	1.44	1.35	1.26	74157	1.56	1.48	1.39	1.31	1.23	1.15
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7460	.26	.25	.23	.22	.21	.20	74192	1.98	1.87	1.76	1.65	1.54	1.43
7470	.42	.40	.38	.36	.34	.32	74193	1.98	1.87	1.76	1.65	1.54	1.43
7472	.38	.36	.34	.32	.30	.29	74198	2.81	2.65	2.50	2.34	2.18	2.03
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50 MEGAHERTZ DX

Paul Schuett WA6CPP
14472 Davis Road
Lodi CA 95240

After I worked some fine DX on six this summer, I have come up with some conclusions to pass along to other VHF devotees:

It would appear that the band is open more than most of us suspect. The problem is that there is nobody around working the openings. Of course, there are lots of people *listening* – it's just that they are all sitting in the shack minding their own business without even knowing about the opening. Since most openings come to light when you hear some exotic contact making some noise, take advantage of the situation and make some noise yourself – so the other fellow can hear you.

The easiest way is to engage in a local QSO, but orient your antennas in various directions. Now and then I'll talk with a fellow eight miles away. Aligning the antenna on a precise aximuth for such a distance is not necessary (the signals are so good that they come in on the noise blanker), so one of us aligns the antenna northeast; the other southeast. We cashed in on this with a breaker from Albuquerque.

There is no need to run out of things to talk about, unless you are particularly boring yourself. Talk about anything – the weather (yesterday, today, tomorrow); articles in the current issue of *73* (if he doesn't have it, you can read the article to him); discuss paragraphs from the FCC Manual (it is surprising the number of people who have forgotten some of the rules, or at least don't use them consistently); practice code, or anything else. We had a 3-way round table that had a break-in from Colorado in this manner. When the other guy hears you, he will come in.

It's a good idea to use your VOX instead of PTT, since you can hear the breaker and not ramble on for another five minutes or so and miss the DX because of changing conditions.

Nobody to talk to? Then make a lot of noise every ten minutes or so. A CQ only takes one line in the log, and you might turn up something fascinating. A fellow from Texas heard my CQ one morning – neither of us had any idea the band was open.

The call CQ DX is silly. If any DX stations hear, you can be sure they will answer; they are as anxious to work double-hop as you are. Most of these calls end up with a local contact anyway, so we are back making noise, which will be picked up on an opening.

Be a gentleman when the band is open. It is amazing how many nice guys turn into fiends with sharpened teeth when the band opens.

1. Don't tune your transmitter on the working frequency. Move up a way; things won't change that much, and the rest of us won't have to work through the carrier.
2. Don't send on top of someone except to give your call. One fellow was calling CQ in CW on top of a DX QSO, making it impossible to hear the stations' IDs.
3. Wait your turn in a pileup. If someone else is transmitting, bite your fingernails until he's through.
4. Don't ragchew in a pileup. Others are waiting. Remember the Golden Rule. Ragchew when it is apparent everybody around has checked in and you have a roundtable going.

My first Ohio contact was marred by somebody hollering *INTERFERENCE INTERFERENCE INTERFERENCE . . .* " all the way through the 4-minute QSO. If this guy has a gripe, let him get on the air and tell me – I'll apologize. Meanwhile, like the rest of us, such a person should simply wait his turn, then give the desired station a call.

These suggestions have been successful in detecting elusive 6-meter openings. Let's not sit around listening – let's make some noise to let the DX know we're around.

. . .WA6CPP

Microwaves

The microwave news this month revolves around a letter sent by Dean Lewis (WA1NOQ) describing a series of commercially available Gunn Oscillators that appear to be cheap, cheap, cheap to make.

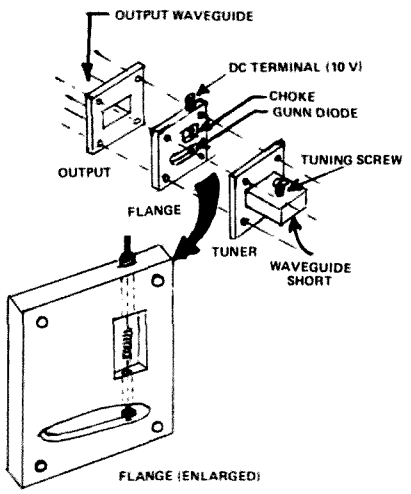
Before describing the Gunn oscillator, perhaps it would be of some interest to define exactly what we mean by a "Gunn" oscillator, or an "Impatt" oscillator. In fact, perhaps this is as good a time as any to make a small comparison between the microwave power generating diodes.

Bulk-Effect Diodes

The bulk-effect devices, made primarily from Gallium arsenide (GaAs) – because silicon and germanium won't work – are divided into two major categories: Gunn devices and limited supercharge accumulation (LSA) devices.

Gunn diodes, invented by J. B. Gunn of IBM in 1963, make use of the fact that a microwave oscillation will "ripple" through the entire semiconductor, much as a wave ripples across a swimming pool. Placing a voltage source across the diode causes these ripples to build up in amplitude until a large useful oscillation results. Voltages required for these devices are low (less than 15V) and are applied in the forward direction at currents up to one ampere. Output powers are from one watt at C band to ½ watt at K band. This is CW power.

LSA devices operate at lower frequencies (L band), higher voltages (up to 1 kV) and higher PULSE power output (2 kW), but do not operate in the CW mode. They were invented in 1967 by John Copeland of Bell Labs. Although they will work well into L-band, they are much more efficient at 8 GHz and above.



Avalanche Diodes

The avalanche devices make use of the fact that a reverse biased diode will reach a certain point where the current will increase astronomically for a small increase in reverse voltage. Some people call this the zenering point, and have noticed that diodes used as zeners generate noise. This "noise" is actually oscillation in the avalanche mode. There are two main modes of avalanche oscillation: Impatt and Trappat.

Impatt (IMPact Avalanche Transit Time) diodes operate on the principle of drift across the reverse biased junction. The time necessary for a particle to cross the junction is the so called transit time, and hence the name Impatt. These particles give rise to a negative resistance characteristic, and hence may be used as amplifiers or oscillators. Impatt devices operate from about 100 volts, and put out oscillator powers (CW) of one watt at S band, rising to 3 watts at X band. Pulse powers of 10 watts and X band and 5 watts at K band have been reported.

Trapatt (TRApped Plasma Avalanche Triggered Transit) diodes typically operate at 1/3 the frequency and 3 times the efficiency of IMpatt devices. In the trapatt, instead of the normal zenering action, a plasma is actually formed which supports the oscillation. CW output powers of 10 watts at 1 GHz and 2 watts at S band have been recorded.

Now, what Dean Lewis sent me was the method used by Fairchild and Microwave Associates to get powers of 50 milliwatts or so by means of a Gunn flange oscillator. These oscillators are meant for low power transmitters and local oscillators in superheterodyne receivers, and are quite adaptable to amateur X band. (For an excellent set of references see: *Electronics* magazine, 1 March 1971, the Fairchild data sheet, "Go(x)-100 Series X-band Gunn Flange" November 1970, and Gunn Diode Circuit Handbook by the Microwave Associates people, February 1971.) The machining necessary to build one of these devices is extremely simple (see sketch) and should be well within the capabilities of most microwave amateurs. The only trouble is the cost of the Gunn diodes. The industrial net price in onesey-twoseys is still around fifty bucks. Hey, how about some of you scroungers digging up a good, cheap source of Gunn diodes. If you dig up a few or a few hundred, I'll be glad to come up with an article for *73* with complete construction details for this particular diode. Until then.

Jim Weir WB6BHI
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MARS

Say, Oldtimer, do you remember the good old days when hams were a friendly, happy, extroverted bunch? Remember when you would attend a club meeting or a hamfest, and fellowship would be boiling over everywhere? When you knew every ham in the entire area, and all it took to get a coffee klatch going was a flip of a switch and a couple of words into the mike? Or when you would join a half-dozen friends on a Saturday morning to help some fellow put up a better or higher antenna? Do you recall being saddened when a fellow ham suffered an illness or a reverse, or rejoicing with him in his triumphs? Do you remember when becoming a ham made you a member of a very special fraternity with an informal motto of "All For One and One For All!"

Hello, young man! So you're a brand new ham, huh? Gee, I'll bet you are proud of that ticket! I notice you are sort of wandering around all alone – where are all your friends? Oh, you don't know any other hams except on the air! Do you wonder how you can break into that loudmouthed group having so much fun over there? You say you haven't been able to find any members of that happy, unselfish group that you have always heard made up the wonderful amateur radio fraternity?

Well, here s news for both of you! That fraternity which you so fervently seek is alive and doing well! You haven't been able to find it, simply because the particular type of ham that makes up the majority of such a group moved off the ham bands and is now operating as a member of the Military Affilitate Radio System – MARS!

It s not that these people are no longer hams – heaven forbid! They are still interested and active in all facets of ham radio – it s just that they have banded together with others who have similar interests, such as emergency communications, handling morale-type messages or phone patches from overseas military personnel, while at the same time learning to be rapid, efficient communicators, and having a ball on the military two meter repeaters!

The MARS membership includes teenagers and octogenarians, generals and privates, housewives and career girls – people from all walks and economic strata, bound together by a simple and sincere love of the MARS way of life. Nor is ours a static (sorry

(continued on page 146)

50 MHz BAND

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VE4 "Morning After" has been joined by VE4 "Morning Prior," both from Winnipeg. Mike runs a modified SB-100. Welcome to 6, Mike – very pleased to be your first contact. Another VE4 heard for the first time from this QTH, is VE4YW.

VP5RS was worked immediately following the above contact with the beam still north. Signals were 5-9 in that direction, climbing to 25 over when the beam heading was optimized. Bob reported 550 contacts during the first 50 hours of operation. Arizona was the best DX to that time. This station made contact four of the first five days of operation, but signals never again approached the level of the first day. Thanks are due to Bob, Hoppy and Joe, as well as Bert and Tex of XE2XN and Allan 9P63N, for providing a little spice to what in this area, at least, was a rather blah contest week end. It is understood that Allen is to be a permanent fixture on Barbados, has a code wheel going, and may be expected to supply many interesting contacts in the future.

In connection with the above, split frequency operation is difficult for the transceiver owner, but there is a way around this if the rig is an SB-110 and there is another SB series rig in the shack (100–300–400). A short length of RG 174/U with a phono connector on one end is plugged into the LMO of the low band rig. The opposite end is connected to ground and the coax removed from the PC board pad which forms the junction of C38 and C39. After this installation it is possible to transceive on either LMO or operate split frequency using the internal LMO for receive and the low band LMO for transmit. Plugging the LMO into the crystal socket or the crystal oscillator grid and ground will not work. The rotation direction in the low band LMO is reversed, making it necessary to tune backwards (50.110 is .390 on the LMO dial.)

Numerous reports this month of KL7 contacts from the west and southwest – calls mentioned include KL7GFB, KL7GLL KL7HIF, and K7WXW/KL7. KL7DFE was also mentioned, but I suspect this is a misunderstanding. GFB and DFE sound very much alike. W4GDS finally QSO'ed a VE7. Bob needs only KH6 and KL7 for WAS. A number of California stations made the WAS list by contacting Art, WA1EXN, of Maine. Dave WA7JEI tells me he worked PY9GM on CW May 27th with 3-3-9/4-4-9 reports exhcanged. K4RNG, the only rebel from Ohio, is back on the air on a limited basis. I am sure friends all over the country wish Les a speedy and complete recovery. Six meters hasn't been the same without him. VE5US remains active with Doug doing most of the mic work. SYL is still around but deeply involved in other projects and not getting on the air much.

WAØTXV points out something which is obvious yet commonplace. Bob mentioned the practice of many working scatter during the contest to repeat the callsign of the called station over and over again after the effort to pass information was under way. As Bob says, "The station called knows his callsign, he wants to know yours." To this I would add the advisability of always *calling* on the same frequency (except in the case of QRM) during skip and scatter operation. All too often you hear a signal, get a portion of a callsign and are waiting for a QSO to end or for an opportune moment, only to have the signal disappear completely. After waiting for a period of time and not hearing anything further, you tune a little and discover the desired station up or down the band, then the whole procedure starts over. Tune if you will, but return to the same frequency to call and you will receive greater benefits for the hours spent.

On the 27th of May, while in QSO with WB4WXZ, "VUQ9W" joined in. His conversation, as relayed by Dave, consisted of the information that he was located on an island off Australia so small there was no callbook listing. The transmitter was 5 watts AM, solar battery powered because there was no source of commercial power available. It was stated that no QSL should be sent because there were only two mail deliveries per year. "John" was coming home in five months and would at that time contact all stations worked. Over the period of the next hour and a half or so, this station made numerous contacts with Florida stations, all strangely reporting 5-9 signals with their beams North. There must be a truly bright moon over the South Pacific! I trust the FCC noted the striking similarity in callsign to that of a well-known SSB hater in the north-central area.

Many thanks to those who included an SASE with their request for the list of TV manufacturers who supply TVI filters or help on problems related to 50 MHz operation. It has been a pleasure corresponding with many of you and I hope it has been worth while from your viewpoint, too. As always, activity reports, questions about 6 meters, TVI problems, and what have you, are welcome .

73 . . . WAØABI

DX WORD GAME

Buried in the maze below are the names of at least one hundred "good" DX countries. The names may read forward, backward, up, down and diagonally. A letter may be used in more than one name. How many can you find?

A	U	S	T	R	A	L	I	A	N	O	W	I	S	H	T	E	C	N	A	R	F	T	I	M	P	E	C	F	O
R	F	R	A	L	L	A	Y	N	E	K	R	A	M	N	E	D	H	G	O	I	T	I	A	H	O	E	A	D	A
G	M	G	H	A	N	A	E	A	U	N	M	A	L	G	E	R	I	A	N	T	O	C	I	O	Y	I	M	M	I
E	E	M	H	N	T	O	H	W	T	E	E	U	E	A	I	S	N	L	D	O	F	L	T	L	P	O	E	H	D
N	R	O	D	A	V	L	A	S	L	E	X	E	B	R	O	D	A	U	C	E	I	I	O	O	D	R	R	P	O
T	A	R	R	T	N	I	T	T	Y	E	I	T	A	M	A	N	A	P	H	P	E	N	I	G	Q	U	O	I	Z
I	R	O	C	U	T	I	K	O	M	B	C	A	N	A	D	A	R	O	P	W	N	H	N	F	O	X	O	J	M
N	O	C	U	H	M	O	S	B	P	T	O	I	O	E	D	L	O	I	V	A	T	I	A	L	B	A	N	I	A
A	B	C	E	B	H	R	O	T	T	H	E	S	N	E	L	R	N	A	Z	E	K	A	I	B	M	U	L	O	C
Y	E	O	G	T	B	U	R	M	A	O	R	E	A	C	Y	E	D	G	O	O	R	I	B	U	R	U	N	D	I
O	R	B	O	E	R	T	H	A	Y	N	G	D	L	E	S	H	L	N	E	I	C	K	S	W	E	D	E	N	R
E	T	S	L	G	I	N	C	S	B	I	N	O	T	E	Y	T	O	T	F	L	A	G	U	T	R	O	P	D	A
B	E	L	G	I	U	M	F	U	I	A	U	H	T	R	D	E	I	U	R	S	C	O	O	R	A	E	A	N	T
L	A	G	E	N	E	S	E	D	L	A	I	R	E	G	I	N	I	G	E	R	G	O	C	O	U	N	D	D	S
I	N	D	T	E	N	W	Y	A	A	O	R	S	E	A	U	N	I	T	E	D	S	T	A	T	E	S	N	R	O
B	I	F	D	R	C	A	E	N	E	N	D	L	A	P	E	N	O	R	W	A	Y	F	N	A	T	A	A	H	C
E	C	S	W	I	T	Z	E	R	L	A	N	D	E	R	S	I	I	B	R	O	R	E	O	U	L	G	L	H	G
R	K	T	F	D	W	I	E	R	H	W	T	H	O	N	T	C	A	T	I	J	I	F	M	O	A	L	E	L	U
I	E	M	E	E	N	L	A	C	R	R	A	C	I	A	M	A	J	E	E	C	A	S	P	A	I	N	R	E	A
A	L	T	N	E	D	A	E	G	H	U	B	U	L	G	A	R	I	A	A	D	L	W	E	P	N	H	I	O	T
Y	Y	Y	R	A	G	N	U	H	H	O	E	Y	E	S	N	A	D	R	O	J	A	P	A	N	A	T	R	U	E
U	E	L	D	I	N	D	T	V	T	H	S	S	T	O	B	G	E	S	E	L	F	R	Y	E	M	E	N	E	M
G	K	C	U	B	A	D	E	I	V	N	D	L	E	N	T	U	N	I	S	I	A	T	A	U	O	N	I	T	A
O	R	E	D	M	S	N	O	T	A	A	Q	U	O	T	E	A	S	O	F	G	A	D	U	B	R	A	Z	I	L
S	U	M	E	A	E	R	I	R	C	A	A	R	I	V	N	N	O	M	U	R	T	N	S	O	R	H	A	E	A
L	T	A	N	Z	A	N	I	A	R	I	C	U	T	H	A	D	L	A	N	D	W	A	T	L	O	E	A	R	N
A	M	E	U	R	W	O	R	I	L	A	D	G	A	B	C	K	Y	L	S	H	A	L	R	I	L	R	P	O	A
V	U	E	L	I	H	C	M	D	S	I	V	U	A	A	N	D	I	T	K	R	I	E	I	V	S	S	H	N	Y
I	L	A	M	A	B	H	O	N	D	U	R	A	S	O	U	T	H	A	F	R	I	C	A	I	O	T	H	C	U
A	L	S	E	N	O	D	N	I	V	O	R	Y	C	O	A	S	T	A	T	S	B	I	U	A	E	N	I	U	G

(For our best effort, see page 86)

AMSAT NEWS

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When Oscar 6 is launched many amateurs will want to process the Morse code telemetry data coming from the satellite. This can be done in a number of ways, first the code could be copied down by hand, but this is a tedious and time consuming process. A much better way is to use a Morse code to teletype converter. Then feed this into some form of home brew computer. With the proper program the data could be printed out in engineering form, such as volts, amps, degrees centigrade, etc. The results could then be sent to AMSAT (PO Box 27, Washington DC 20044) either by mail or over one of the HF radio links.

A-O-C when in orbit will be identified by a Morse beacon sending the letters HI (. . . . . .). This will precede and end each telemetry transmission, so that telemetry or CODESTORE information will be easily recognizable. The beacon will operate on 29.45 MHz within the repeater passband and will have an expected output of 0,2 watts.

CODESTORE

CODESTORE is a Morse code message storing system. It is a static shift register memory which is loaded from the ground through the AMSAT command network. After loading CODESTORE will repeat the same message until changed by ground command. CODESTORE will operate on the 29.45 MHz CW beacon. The memory length of A-O-C's CODESTORE is 768 bits, this is sufficient to permit storage of approximately 15 words in Morse code. The device is set to retransmit messages at 13.4 wpm, at this speed teletype characters can be recorded in CODESTORE and retransmitted to the ground at one-quarter standard 60 wpm teletype speed. To decode the teletype, one need only to tape record the message at 1-7/8 ips and play it into a teletype system at 7-1/2 ips. It will be entirely possible to store teletype messages up to 96 characters long by this method. A good example of the use of CODESTORE is shown in the following message: "orbit number 2109 had an ascending mode equatorial crossing at 1101GMT at 101 degrees west longitude. For later orbits add 115.113 minutes to the time and 27.781 degrees to the longitude per orbit." This would be read as: "ORBIT 2109 1101Z at 101W ADD 115.113 MIN AND 27R781 DEG PER ORBIT." In addition, emergency and request messages can also provide CODESTORE with many uses.

A Morse beacon operating on 435.10 MHz is also planned for A-O C. If it's completed in time it too will be used for telemetry or CODESTORE CW transmissions.

MARS *(continued from page 144)*

about that!) organization – our membership includes some of the finest technical brains to be found anywhere! Example: Third US Army MARS owns the world's entire supply of 2300 MHz moon-bounce operators – A4HHK and AA4RJ! Army MARS became operational in February, 1948. In order to keep the organization abreast of the times and state-of-the-art, periodic meetings and conferences are held at all levels where problems are outlined and solutions offered. Such a conference was recently held in Washington – and attended by *every* Command MARS Director in the United States, Europe, Asia and the Pacific!

If you are still not convinced that such an organization exists, that there is such camaraderie, fellowship and goodwill, just walk over to the MARS meeting being held at the next hamfest you attend – you will be welcomed! How can you become a part of this outstanding ham organization? Simply address a card, letter or radio message to:

Harry Simpson A4SCF
c/o 73 Magazine
Peterborough, NH 03458

THE TRAVELING HAM

OR, THERE'S MORE THAN ONE WAY TO GET A QSL CARD

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There is no need to tell those of you who travel overseas the advantages of being a ham. If you haven't yet been abroad, let it suffice to say that the enjoyment and education provided by any trip can be multiplied many times over by eye-ball QSOing with hams of other countries. However, there are important do's and don'ts when attempting to meet our foreign brethren. If you follow the following suggestions I've carefully outlined, your chances of a successful encounter will be much greater.

Once you have selected your itinerary, turn on the rig (no, not the one with the channel selector, the one with the VFO) about a month or two before departure. Look for hams in the countries you want to visit and tell them that you are planning a visit to their country on such and such date. Don't push them, but if they seem interested in meeting you, ask for their phone number, both at their home and where they work. Most will be very pleased at the suggestion. Keep in mind that no one is better qualified to suggest hotels and restaurants than these hams (but tell them what kind of accommodations you are used to). Also, you might ask them when their local radio clubs hold their meetings. Often they are weekly rather than monthly and you may wish to rearrange your itinerary slightly so that you can attend. This is a good way to meet many hams in a short time as well as an interesting way to hear their problems, which usually are very different from ours. (I don't remember one African club ever once mention TVI!) Say 73 and keep tuning – don't stop with one ham. It wouldn't be the first time to happen if you find your DX friend "out of town," etc. when you reach your destination.

After your suitcase is all packed (I hope you haven't shut it yet), here's what to throw in on top of your nicely folded coat. (If the XYL complains about the weight, take one of her five pairs of shoes out.) Your bible on the trip will be a recent foreign Callbook. (Nothing is more exasperating than to find that no one in your 1962 issue is to be found in the local phone directory when you arrive.) Throw in some of your nicer QSL cards and bring along some new commemorative U.S. stamps – you'd be surprised how many foreign hams collect them. Do not bring your ham rig. It's too big, too heavy, and your crummy portable dipole won't work anyway. Use your new DX friend's rig and beam when you visit his QTH. In addition, you'll never clear your equipment through customs in many countries, especially in Africa and the Far East. (In this article I won't tell you about the conversion from Drake transceiver to Sony FM Stereo where the plate load and tune become the bass and treble controls, and the mic gain turns into a balance control, etc. . .) Only schlepp parts if someone specifically asks you to.

If you already have phone numbers when you arrive, your job will be much easier. Just make the call (be patient with their phone service – it won't be like ours) and introduce yourself. However, please note that

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TRAVELLING HAM
(cont. from page 146)

just because the ham speaks English on the air is no indication that his family also speaks English. Ask for your friend by name or try a key word like "radio" to make yourself understood. When you do reach the ham (don't give up, it might take awhile) tell him about your good impressions of his country and suggest you get together at your hotel for a drink. Don't expect him to rush over to pick you up and take you immediately to his shack. If all you want to do is just get on the air, the best line to use is "I have a schedule with stateside in a half hour and would it be possible for us to give it a try?" (I'll never forget a certain ZS2 who drove about ninety miles per hour down the wrong side of the road to avoid the traffic so I could meet my sked.)

If you arrive somewhere and have no phone numbers, it s time to break out the Callbook. If there aren't too many hams in the city of the country you are in (like ZD5 or VR4), than a quick check with the names in the local phone book will probably be useful. Usually the latest listings, those at the end of the list, will be the newest and most active hams and the most receptive to visitors. Call them first. Those at the beginning of the list (ZX2AA, ZX2BB) are usually not very active, are old, and tired of visitors, but they may know the newer hams and how to reach them. In large cities, the local radio clubs are often listed and can give you phone numbers and addresses of hams. A good example of this is the WIA in the major cities in Australia. The Sydney branch is especially helpful in locating people. In more remote countries go to the local telecommunications office since they are usually the licensing authorities and often know who is active.

If all else fails, use your eyes. When you are in a taxi or on a tour bus, always look up. I have met many people both in large cities and in small VK9 villages by the old "bang-on-the-door" technique. These people are often the friendliest of all and will really go out of their way for you. The surprise factor is always fun, too.

There is a general rule to figure out how receptive hams in given countries will be to foreign visitors. When there are not many hams and a great number tourists, you can expect a lot of door slamming, not answering the phone, and disconnected doorbells. A good example of this case is Greece (Athens) or Fiji. If there are not many visitors, but lots of hams, expect the royal treatment. This applies to most of the larger African cities like Johannesburg and Salisbury. If there are very many hams and also a large number of visitors, you will still have an enjoyable time. This applies to Japan and Australia. In the case of countries where there are only one or two hams, but very few visitors (i.e., VR4, ZD5, VK9), you will probably enjoy yourself the most. Usually the hams in these places are the nicest you'll meet anywhere since they generally have much free time with little outside pressures or excitement which means that your arrival merits more attention. Needless to say, it's also more fun to get on the air from these places.

As a final hint, never expect anyone to do anything for you – you'll be much happier this way. And if nothing else, remember that you are the guest in any other country, and that when you travel you are your country's number one ambassador to the people you meet. Your actions ,courtesy, and politeness reflect on every one of your countrymen and if you act like you do in a pile-up, you'll hear your friend in the foreign, and not in the American phone band. Have a good time!

EVER HAVE A DREAM COME TRUE?

Sheldon K. Davis
98 Rex Avenue
Indiana, PA

Since Indiana, Pennsylvania is known as the "Christmas Tree Capital of the World" I have often thought how great it would be if there were a call available with the word TREE in it. Then along came the FCC with their special call signs.

I planted and nurtured the idea of the special event call of WT3REE in many club meetings – and suddenly it bore fruit! Helpers and club sponsorship were obtained.

The next hurdle was the FCC and their permission. Letters and phone calls established the fact that such special calls were getting harder to get. But – our request was a little unique – so permission to use it for four days in May to coincide with our local Christmas Tree Candlestick Festival.

Why a Christmas tree celebration in May? Easy! It's too cold in December. In addition, we are too busy cutting and shipping nearly a million plantation grown Christmas trees for shipment all over the world. In the merry month of May, the new growth on the evergreen trees resembles "candles" on the boughs. So the local leaders elect a Queen Evergreen, invite commercial exhibitors, local service clubs and others to get activities and ideas that will help separate the tourist from his hard earned buck.

It works too. About 20,000 people attend, eat hot dogs and pancakes, view stage shows and take tours of the "tree farms." About 400 campers used the event for a "camp-in."

Our local radio club borrowed a crank-up trailer from a dealer, scrounged up a big tent, set up rigs, made signs and handouts, put up antennas and were in operation WT3REE caper. Of course "little" things like hassles with the electric company about power. Oh they were willing, and even ran power to the top of an adjacent pole. But we couldn't get together with proper safe and acceptable material for the "bottom" of the pole. Ham ingenuity came through, though. All rigs and lights were operated from one little light socket in an unused ticket booth nearby (which permission was also hard to come by!) Antennas were strung up with the usual fun and havoc. They even worked – mostly!

Operators were easy to come by – at convenient times and with competition from a hamfest. Fortunately, a dedicated few braved the wee hours to make over 600 contacts in 24 states and Canada. Many listeners failed to see the TREE in the call WT3REE – but were happy to get the special contact anyway. Many more contacts might have been made but much rag-chewing went on both on CW and phone. But then again, that was the real purpose: to publicize the county and its tree industry!

Comes now the battle of the QSLs. The local Tourist Promotion Bureau is helping with the cost of the cards – but someone has to sit down and fill them out. A SASE was requested but some failed to get the message. We

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SSTV SCENE



It is really fascinating to see the programs some of the slow scan boys have worked up. Here one really has a chance to show originality. (Woe be unto us if K1YSD ever gets on slow scan!) Here's some thoughts to keep in mind when recording them when the band is dead and you have time. Try for the same audio level on all pictures. Clean the tape recorder heads (and de-magnetize if necessary) before starting to record. If you are using a battery operated recorder make sure fresh batteries are installed, or else, later when you install fresh batteries you'll pick up hum bars like in the June column picture. Also, make sure the slow scan system is properly calibrated; i.e., sync – 1200 Hz, black – 1500 and white – 2300 Hz. You might also check the 15 Hz horizontal sync rate (by reflecting a small amount of light from a lamp or VR tube onto the camera or phototube, or by pulling a ground on the video loose temporarily). Four vertical hum bars indicate 15 Hz. They tear to the right or left if the frequency is too high or too low. If you have Robot gear, turn the contrast to 9 o'clock and adjust the camera's controls to produce the best picture definition. This will assure maximum frequency deviation from the camera. A few minutes to check these few points will repay you ten-fold with quality pictures you'll enjoy sharing with other SSTV'ers for many times to come. And don't be afraid to splice pictures – they'll mate up quite easily with a little experience. Tapes not only provide a larger picture to time ratio, but they also free the camera and/or flying spot scanner for live relays.

I recently toured the radar facilities of an airport control tower, and a rather large ship. Those 14 and 16 inch P7 tubes really caught my eye. They also carry a few spares. A possible source of large screen P7s? Check around. . .they are more plentiful than the old 7290 slow scan vidicon.

Say, when are some of you YLs going to get on SSTV? If you think you rock pile-ups now with the feminine voice wait 'til you try slow scan and show yourself around. Gals are better to watch than receiver dials anytime! Come on – get "in" and on. . .SSTV.

The slow scan picture this month comes from Paulo, PY1DCB. This was sent from W6TEZ and was Paulo's first attempt at slow scan photography. Now he is in trouble with the XYL and wonders if anyone knows what magazine the pix was in. Sure that's not your next door neighbor, Paulo? Any rate, a very high resolution picture, with good gray scale and no QRM. You non-slow scanners – you are too close – hold the book at arm's length and look at the picture – don't read it.

Incidentally, a lot of fellows have been having a ball photographing pictures directly off the screen. This is most easily accomplished with a Polaroid camera (since the results can be seen immediately). Set the camera speed for a time exposure so when the shutter is opened it will stay open until you release it. A camera shop can make this modification if your camera doesn't have it. Openings of F4 or larger are sufficient for photographs with 4000 speed film. Place the camera squarely in front of the monitor (a tripod or stack of books may help) and open the shutter at a slow scan picture top, when you hear the vertical "blip," let the trace sweep down the screen its 8 seconds, then close it. (You did remove the yellow filter didn't you?) You will probably need to turn the brightness down, producing a dim picture on the screen, since the blue initial trace produces the picture on the film, and too bright a trace will "bloom" and not leave dark areas (washed out print). A close-up lens added to the camera will produce pictures almost as good as the ones on the screen, and will fill the photograph almost entirely. W4RKS made a nice monitor camera using an old Polaroid camera (lens swapped to 50mm, and refocused on film to produce close-ups) with a minibox bolted to the front. The minibox then fits onto the monitor firmly and the screen is viewed through a peep hole in the top. I believe Tectronics makes one like this, but the cost is around $300.

The other picture this month is from Franco, I1LCF and is a photo of the 1st prize of CQ Electtronica's slow scan contest, a Silver Thaler of Maria Theresa. It went to Don Miller, W9NTP. Congratulations Don!

Don't forget to drop me a card if you would like to see a U.S. Slow Scan contest this winter. These cards are our "poll" on how well the contest would be received.

. . .K4TWJ

EVER HAVE A DREAM COME TRUE?

(continued from page 148)

hope to QSL 100% with all contacts. I hope that patience is a virtue of all hams (it is isn't it?).

The outstanding event was a visit from Ann Parks, the newly elected Queen Evergreen IX to the ham shack. She had never heard of ham radio so was duly impressed and surprised to find herself in conversation with WB4OWW down in St. Petersburg, Florida. She mentioned that she had an uncle down there. At this point, Jim, WB4OWW, spent much time in tracking down the phone number of the elusive uncle.

Finally the young lady jumped up and down with youthful joy and enthusiasm crying: "That's my Uncle Bob!"

And it sure was! The little Queen was able to tell her uncle of her election to Queen the night before. Both Jim and the local ops were proud and honored that we were able to make a little lady happy by her introduction to ham radio. Who knows: maybe a future YL op?

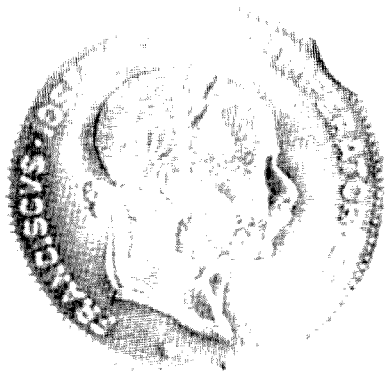
We made many mistakes – and many sins of omission! But we did make many contacts and helped many hams with a rare and exotic call sign. It is a great feeling to be on the other end of a pile-up.

One of the big – really big – outcomes was the cooperation and help from our own club members as well as assistance from the local VHF club. It was a great way of coordinating and consolidating club members and increasing club morale.

The local public relations – with help from the local news media – was also a plus to the event.

Yes, dreams do come true!

. . .Davis



LETTERS

Regarding the comment by K9MGX on page 4 of the June issue, for your information, a 73 dB acoustic level certainly is not near what is normally considered the point of ear damage, (although this is loud). In addition, this figure is meaningless unless you specify whether it is rms or peak. But, either way, a symphonic orchestra is well-capable of levels in excess of that figure in an acoustically "live" auditorium at 50 feet! Are you trying to contribute knowledge or ignorance?

Clyde Wade
Little Rock AR

I'm not the type of person to write letters, but I must write and congratulate you in respect to the articles on old radio pioneers and especially the article on lightning in the June issue (written by W2FEZ).

I'm fascinated and awed when reading these articles by Mr. William Hood. These are always the first articles I read, when I open the pages of a new issue. I have re-read many of his articles several times.

Please publish more of this type of article if possible.

W. Rush W8WAT
Tucson AZ

With the increase in use of Progress Line units, I thought I would mention a few pointers on converting them for 2 meter operation. In the 4ERC25B2 receivers both coils in the antenna transformer T301 should be padded with 4 pF ceramic tubular capacitors. The whole transformer can be removed by disconnecting the coax lead and unsoldering one lead of C5, which comes out of the bottom of the can and goes to Pin 1 of the 6AK5. Remove the 2 mounting screws from the bottom of the can and lift the transformer off the main chassis. Remove the 2 sub-assemblies from the can by taking out the screws on the sides. The padding capacitors can now be placed across each of the trimmers. If any of the rf trimmers (C305, 307, or 310) on the main chassis do not tune, they can also be padded with 4 pF. In the 4ERC25D2 receiver, only the antenna transformer T336 has to be padded (using the above procedure), as everything else will tune ok. In the 30 watt transmitter the final will have to be padded with a 4 pF capacitor soldered directly across the plate trimmer C157. The 50 watt and 80 watt transmitters generally don t require any padding at all.

Jim McCullough VE3CSO

I would like to thank you for publishing the General and Advanced Class License Guides. They enabled me to pass my exam.

Also, I believe that the June, 1972 issue is the best, or one of the best, you have ever printed.

Bob McCormick WB9HFD
Champaign IL

You've finally done it. After all those articles on FM, I have no choice but to go FM. The Gods have willed it, and who am I to argue with them? "Very good," say all you FMers out there. But here's the problem. Being a student, money's a little hard to come by, and when it does, it doesn't go to ham radio. So, if somebody would like to take my Swan 270B off of my hands, I'll use the money to go FM.

I really enjoy *73* but what happened to all of the chicks on the cover?? And Wayne is so crazy that I call him the Evel Knievel of ham radio. Any takers?

Scott Liebling WA3OXG
Pittsburgh PA

I read some time ago that RCA is phasing out the 2N398A, which has been popular for quite a while as a grid-block keying transistor. It was one of a very few cheap, high voltage, PNP transistors. Some of the gang may be interested to know that the 2N5415 has come on the market recently, and at just about the same price. There are a few differences to be aware of, however. The 5415 is a silicon transistor, and its maximum safe reverse bias on the base is 4V, versus 50V for the 2N398A. Its saturation voltage is higher, 2.5V instead of 0.35V. Thus, some circuits may need a little redesign before the substitution will work. On the other hand, the 2N5415 can switch 200V, which is nearly twice as great as the 2N398A. There is an NPN which is complementary to the 2N5415; the 2N3440.

John A. Carroll K6HKB/1
Malden MA 02148

I am not a life subscriber to any magazine, but if the May '72 issue is representative of your standards, you will have my life subscription when my current one expires.

Bill Winstead WA5TND
Philadelphia MS 39350

It would be appreciated if you would announce the formation of the "Purple Martin Net" which will be on 7.251 MHz every Sunday afternoon at 4 PM CST. The purpose of the net is to bring together those amateurs who are interested in this wonderful little bird. WA5MPQ is the NCS and I (W5BW) will be the alternate. Thank you for your attention.

Thomas W Braidwood W5BW
Alternate NCS—Purple Martin Net

You've got to be kidding! Asst. Ed.

Note Asst. Editor. *QST* and *Ham Radio* did not think so. See page 57 June *QST* and page 87 June *Ham Radio* – Now who is kidding. W5BW

Well, different strokes for different folks! Keith, Managing Editor.

Thought I'd QRX from work and drop you a line to tell you how pleased I am with my subscription to *73*. I find it not only interesting, but practical. It's well worth the money (no matter how long it takes to scrape it up).

Whilst down at the Dayton Hamfest, I thought I'd try a little experiment – I subscribed to every major ham mag while I was there and then waited to see who was "on their toes." Congratulations! I received my copy of *73* first. Next in order was *CQ QST* (renewal) and last (even though I had received a postcard saying my subscription would start soon) was *Ham Radio*.

Right now I m working about 11 hours a day at my present job: which leaves almost no time for amateur radio or anything else. But rest assured that I certainly will find time for each issue of *73*.

Keep plugging on Wayne, you're doing a great job!

Charles J. Rabley WA8RUO
Greenville OH

MORE K1YSD?

I was at my friend's house reading through the June issue *73* and happened to notice the K1YSD article. I read it. Two hours later, after reducing my laughing convulsions to short bursts of snickering, my friend's parents asked me to remove myself from the premises. While walking out the door I heard them mumble something like "moron" and "bad example." Now I guess I'll have to subscribe, since whenever I go over to his house, they lock the door and won't let me in.

Joe D. Rippel WB8IMG
Chagrin Falls OH

Step on the Klutz has to be the funniest thing written in. *73* Magazine since Bob, Bob, Bobbin' Along. C'mon Wayne, MORE, MORE!!

Gordon Bello WA1JWQ
Brookline MA

MORE LETTERS

This is in response to your letter of 22 March 1972 concerning amateur radio operations aboard U.S. Navy ships and the morale benefits afforded by such operations.

The morale benefits derived from shipboard amateur radio operations are well recognized. It is the policy of the Department of the Navy to support and encourage amateur radio activities, including those on board our ships. Shipboard amateur radio operations are generally allowed only during extended unclassified ship movements. This limitation is necessary in view of the requirements for communications security, as plain language communications to and from naval ships at sea have been determined to adversely affect our ships' operational security.

Amateur radio operations, as well as other means used for plain language communications to and from our ships at sea, have been a major concern to Fleet Commanders in Chief and to the Chief of Naval Operations from a security standpoint, particularly in times of crisis, and on a continuing basis in the western Pacific. From time to time it is necessary to curtail these operations to preclude the transmission of information over unauthorized circuits, which in the aggregate would be of value to a potential enemy. In area West of 160 degrees East Longitude have been curtailed consistently. Continued security difficulties in the Pacific area caused the Commander in Chief, U.S. Pacific Fleet, on February 1, 1969, to promulgate a directive curtailing afloat and airborne amateur radio operations, hospital ships excepted, within the Pacific Area until such time as active hostilities in that area have ceased. Since that time, the exception has been extended to include all ships on special unclassified operations such as the Apollo Prime Recovery ships.

The policies governing shipboard amateur radio operations are periodically reviewed. After a recent review, it was determined that, although the morale benefits derived from shipboard amateur radio operations are considered to be substantial, the communication security aspects are paramount. Therefore, the current policy will be continued.

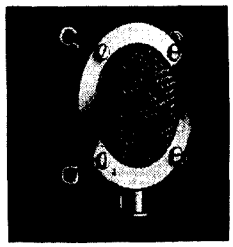
In the event an article is published in your magazine, I would appreciate it if you would express my profound gratitude to the many amateur radio operators, including those affiliated with MARS, for the services they are providing our Navy people and their loved ones.

S.L. Gravely, Jr.
Rear Admiral, U.S. Navy
Director, Naval Communications
By direction of Chief of Naval Operations

Although I hated like fury to cut up my new *73* and my 1935 Rayo catalog, I just had to draw your attention to how little the venerable 104 mike has changed in 35 years – practically none!



From Ham Buerger ad, 1970: $25



From Astatic ad, 1935: $25.20

Odd how the pictures were taken from the same perspective and that the price is virtually the same. The only difference in the 1970 model apparently is the omission of the eyelets for ring suspension.

Bob Kuehn WØHKF
St. Paul MN 55118

How about a *73* oriented brain-teaser?

A group of chess playing hams planned to have a round robin chess tournament on the air. When the schedule was set up, 153 games were just too many. So they split into two equal groups and played two round robins, and the winners met in a play off. How many games did that arrangement take?

John Hunt
Pittsburgh PA 15236

ANS. A round robin takes n(n–1)/2 games.
So n)n–1)/2 = 153 given 18 men.
A 9 man round robin plays 36 games. Two of these plus the play off gives 36 + 36 + 1 = 73!

May 1 bring up one small point not mentioned in the aritcle "Easy Amps" in the May issue? This metering circuit monitors the current from or to the auto battery by measuring the voltage drop in the ground cable. This ground cable also is used in the starting motor circuit, and starting motors pull on the order of 200 amps when the starter has a normal load and much higher under abnormal conditions (the engine stalled in the middle of a traffic intersection on the hottest day of the year, and the air conditioner has been on all along!). One might wish to check this out before commiting a good meter. Of course, it will depend on what kind of overload the meter will take.

A similar current monitor scheme is used on many late model full size Chevrolets (especially the 1965 models) These particular models have the battery on the right, the alternator and regulator except starter motor current, is fed thru a number 12 or 10 red wire that goes across the top of the radiator frame. The factory option ammeter uses the voltage drop in this four foot wire. This method puzzled me for a while, a few years back, when I removed the idiot light cluster and replaced it with an option gauge cluster from a wrecked Impala Super Sport, and I could not find the meter shunt!

Sheldon Daitch WA4MZZ
Louisville GA

I have come up with an idea. Maybe it will or it won't work, but anyway, here it is. Since it is possible to transmit SSTV on the HF bands, why not have SSTV on FM subcarrier transmission on the VHF bands. It could be demodulated through a receiving setup similar to that of FM stereo. The main carrier could have a pilot signal or subcarrier of say 2 kHz, or possibly a subaudible frequency, or maybe a radio frequency in the VHF range, say of about 10 or 20 or 30 kHz. The only problem being that most FM signals are now being transmitted on narrowband deviation, and not wideband, in order to comply with "the-state-of-the-art" and modern receiver bandwidths. This system, of course, could be used on 1296, 220, or 450 MHz, or even 2 meters (in an unused portion of course).

Getting back to demodulation, however, the pilot signal would be the "television" video and the main "corner" the audio portion. This, of course, could be made narrowband by using a "pilot" signal or subcarrier of about 1 to 2 kHz, way below the standard deviation of 5 kHz, in use all over the country today. Is this possible? It could be, if some other hams who are interested could write to me at 50 South Porter St. Manchester, NH 03103. Any suggestions or comments would be welcome.

Michael J. Kane WA1PJG
Manchester NH

We had an odd situation here in NYC March 11th. I was on duty in the Empire State Building at altitude of 1000 ft and could see the snow coming down in a real blitz, not only nice white snow, but also big blue lightning flashes . . . on my way home I noticed that two cars with "burglar alarms" were blasting away. The guard at the exit of the building told me that they went off when "we had that big blue flash." So it seems these devices are capable of being triggered by external fields of extremely high amplitude, transient nature.

Neil W2OLU
NYC

Solid state alarm control systems can respond to transients caused by electronic fields such as lightning.

Caveat Emptor?

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For $1 extra we can maintain a reply box for you.

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FOR SALE HT-220 450 WALKIE-TALKIE tuned up and ready to go–$300. 4 Ch. Motran tuned up on 2 meters–$300. Phil Theis, K3TUF, 428 Estelle, Philadelphia PA

HOT AS A FIRECRACKER That's the upcoming ARRL Hudson Division Convention, Hilton Motor Inn, Tarrytown, NY. October 21-22 are the happy days. So spend your July 4th weekend anticipating exhibits, lectures, 2 meter FM RTTY, contests, gabfests, New York sightseeing, fun. It's a blast! Write Dave Popkin, 303 Tenafly Road, Englewood NJ 07631. He'll fire off the info to you.

2 METER FM TRANSCEIVER $150. Inoue FDFM 25. Solid state, 5 watts, 6 channels (2 provided), w/Turner 350 mic. Mint condition. 213-799-6543 WB6ALS, 2023 Huntington, South Pasadena, CA 91030.

ANY REASONABLE OFFER accepted for DX100, SX100, DX40, TBS50, Globe 90, BC348, 8506B, 8503, 88LF, T18, T19, T20. Box 8352, Savannah, GA 31402.

FACSIMILE Frequency Shift Facsimile Converter CV-2A, in like new physical condition – $58; Full size AN/TXC-1 facsimile recorder (weather map type) – $99. Both together – $145. Small size "Desk-Fax" transceivers – $15, two for $25. Also, variety of fax papers. Stamp for list. Jim Cooper, W2BVE, PO Box 73-M, Paramus, NJ 07672.

SALE Drake Novice XMTR 2-NT – $95; Johnson Viking I Kw matchbox model 250-30-3 – $125; Both mint; Walt WA6FAQ, 136 Bidwell, Vallejo CA 94590.

SWAN CYGNET 260 ac/dc supply, Mic. 80 10 mobile ant. – $300. Phone: (603) 524-0716.

FOR SALE: Teletype tape printer, $5; RT-159/URC-4 walkie-talkie on 146 mc. w/batteries, $10; RT-285/URC-11 walkie-talkie, $5; MD-7 modulation xfmr, $3; AM-8/TRA-1 70–100 mc. amplifier, $8; I-122 freq. meter, $7; TRC-8 230-250 mc. antenna, $3; 3-el. 6 meter antenna w/spare elements, $4 Plus postage. WB4GEW, 3344 High Hope Rd., Lexington KY 40502.

NATIONAL AMATEUR CRYSTAL BANK A central receiving, testing and matching service for exchanging 2 meter FM crystals. Send SASE for details. National Amateur Crystal Bank, Dept. 73, PO Box 1, Wykagyl Station, New Rochelle, NY 10804.

WANTED COLLINS Mechanical Filter 455-FC-60 or equiv. 6 kHz BW for Hammurlund HQ215 Rcvr. W1FOT/KV4 Box 3374, St. Thomas USVI 00801.

FOR SALE Hallicrafters SR42a and HA26 with four crystals, mike, antenna and handbooks. Complete two meter station. Mint condition in original cartons. Will pack to ship freight collect. $155 certified check or money order. K6UQC, 6028 Ellenview, Woodland Hills CA 91364. (213) 888-1522.

CINCY STAG HAMFEST: The 35th Annual STAG Hamfest will be held on Sunday, September 24, 1972 at the ALL NEW Stricker's Grove, on State Route 128, one mile west of Ross (Venice) Ohio. Check local area map for new location. Door prizes each hour, raffle, lots of food, flea market, model aircraft flying, and contests. Identify Mr Hamfest and win prize. $5.00 cost covers everything. For further info, contact: John Bruning W8DSR, 6307 Fairhurst Avenue, Cincinnati, OH 45213.

VHF NOISE BLANKER Models available for VHF transceiver and receiver-converter systems. See advertisement in July issue 73. WESTCOM ENGINEERING, Box 1020, Escondido, CA 92025.

YOUR CALL LETTERS Two sets, for windshield and rear glass. Smart white letters with red outline. Easily installed pressure sensitive decals. $1.00, postage paid, anywhere. Satisfaction guaranteed. Lake Jordan Artists, Slapout AL 36092.

NO QRN Wyoming ranch land, Wild Horses, Antelope, Deer. 10 level acres $20 down, $20 month. Mike Gauthier, K6ICS, 9418 E. Florence, Downey CA 90240.

HAMFESTERS 38th Hamfest and Picnic, Sunday, August 13, 1972, Santa Fe Park, 91st and Wolf Road, Willow Springs, Illinois, Southwest of Chicago. Exhibits for OM's and XYL's. Famous Swappers Row. Information and Tickets, Joseph W. Poradyla, WA9IWU, 5701 S. California Ave. Chicago, IL 60629.

FM IC-20 & REGENCY-2A owners, Now Available, 4 frequency tone burst oscillator, internally mounted. $29.50. Bob Brunkow 15112 S.E. 44th Bellevue, WA 98006. Phone 206-747-8421.

FIGHT TVI with the R.S.O. Low Pass Filter. See p115, March 1972, 73. Write for brochure. Taylor Communications Manufacturing Co., Box 126, Agincourt, Ontario, Canada.

FOUNDATION for Amateur Radio Annual Hamfest, Sunday 22 October 1972 at Gaithersburg, Maryland Fairgrounds.

...AND MORE!

I always thought in your magazine and Repeater Bulletin, the "Letters" section was devoted to letters to you, but I find in Bulletin No. 5 a copy of a letter to *me* from Dick Morris, K1WZR complimenting our service. Thank you very much for including it ... it was really a surprise, although I noted on Dick's letter that he did send you a copy. To me, after putting in 10 and 12 hours daily, then several sleepless nights weekly due to ideas "buzzing around in my head" about how we might improve our service to customers and build our business – after all that, the sweetest sound in the world is a letter of appreciation like this one.

We're building our business on service, Wayne, and I feel much like a friend who was recently trying to "dream up" a spare-time business: He said "I know there are many people out there who are willing and anxious to spend money on some service I can provide – all I have to do is find out what it is." In our case, our decision is what we can offer the amateur that will make him decide to deal with us rather than our competitors, and the best answer we've found is service. We've been told as we grow, our ability to offer such fast personal service will decrease. I hope not, and am formulating plans to insure that it won't. As of now, however, we *can and do* provide it, and letters like Dick's are an excellent way to get this message over to the amateurs, and we do deeply appreciate your help in this rather unusual way!

Ed Juge W5TOO/W5NGL
Fort Worth TX 76110

Alton E. Glazier K6ZFV
3154 Jordan Road
Oakland CA 94602

HOME AND AUTO BURGLAR ALARMS

In designing these circuits, the following three points were kept in mind: One, reliability; two, simplicity; and three, low cost.

The home burglar alarm uses magnetic reed switches (normally open). They are composed of two halves. One half is a magnet, the other half is a switch. One complete unit is required for each door and window. The magnet half is embedded in the top of the door or window, the switch half is embedded in the top of the door or window jamb, with connecting wires.

The embedding is done with a router. The relay is a single-pole contact with a 12V coil. The contact rating is determined by the amount of current necessary to activate the alarm (horn or bell). As will be noted from the diagrams, no current flows until one of the switches is activated. When this takes place, the relay closes, thus completing its own electrical path, so even if doors or windows are closed after opening, the alarm will keep going. The only way it can be stopped is by either the key switch or the battery running down. Naturally, a time relay may be used to shut off the circuit after a predetermined time. However, I prefer continuous operation. Battery life is normal shelf life unless the system is activated.

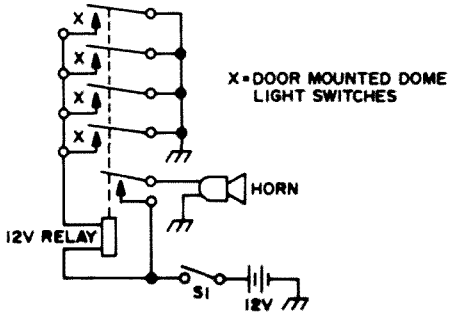


Fig. 1. Auto alarm.

The automobile alarm uses the existing dome light switches which are embedded in the door jambs, and in no way alters dome light function. Also, the alarm horn is the existing horn. The key switch to activate or deactivate the system is placed in some inconspicuous place on the body of the car. If the hood is to be protected, use a magnetic reed switch or a mechanical switch, so that when the hood is closed, the switch is open. The wire from the battery to the relay contacts and from the contacts to the horn should be at least #10 wire.

. . .K6ZFV

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Please either tear out this list of advertisers and send it in to 73 with as many boxes checked off as you would like to see brochures, data sheets or catalogs . . . or else make a copy and send that in. Include your zip code, please.

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I have a little bad news for some Technicians who use repeaters. Several citations have been issued to users of the Los Angeles WB6ZDI machine which uses 146.610 as the input and 147.330 as the output. Both Richard Burton, WB6JAC, and Carl Siminow, WA6JOW were cited for "OPERATING ON A FREQUENCY NOT AUTHORIZED FOR TECHNICIAN CLASS LICENSE. NON-COMPLIANCE WITH SECTION 97.7 (c) OF THE FCC RULES AND REGULATIONS." I was under the impression that a Technician could legally be transmitted out of his segment if the licensee of the repeater had a General Class license or higher. Not so says the FCC. I had a very interesting telephone conversation with Mr. Jack W. Bazhaw, K6FLO who is the Engineer in-Charge of the Santa Ana, California FCC Monitoring Post. Mr. Bazhaw, himself a repeater user. (W6FNO) explained that the FCC considers it illegal for a Technician Class licensee to be retransmitted out of his frequency authorization. The important point to note here is that the FCC puts the burden of responsibility on the Technician and not the repeater owner or licensee. I know of several repeaters around the country with an output above 147 MHz. I know there are many Technicians innocently using these machines and not aware of the Commission's decision. Hopefully, Docket 18803 will solve this and other problems. However, until 18803 is acted on, remember, it is illegal for a Technician to use a repeater with an output above 147 MHz. I realize some of you are asking, "What if the Technician does not realize he is being retransmitted out of the band?" I know there are a few areas of the country where, because of several repeaters using common inputs, you can transmit and never know on how many frequencies you are being repeated. I am afraid that there is just no way you can be sure, especially if you have a good installation for a base station and operate during the frequent band openings on two meters.

While we are awaiting the outcome of Docket 18803, the Europeans have made their decisions and rule making for repeaters. Their new rules and regs parallel those of the United States, in many ways. I am told the delegation used areas of our country where the repeater operation is organized for their guide. They used southern California to show how not to do it. I greatly admire the southern California group. They were, for the most part, responsible for the rapid growth and acceptance of FM and repeaters. However, times are changing. The entire country, with the exception of the southern California area has organized and standardized. Without ruffling any feathers, I do urge the repeater owners and operators in that area to follow the trend of the country and now Europe.

Back to the FCC, on another subject, the Commission has authorized U.S. amateurs to communicate with XV5AC near Saigon. So, another restricted country is back on the OK list.

I was invited down to Philadelphia on June 17 for the first annual Kassvention, along with such people as Bob Cushman of Cushcraft, Sam Rainwater for Henry, Doug Horner from Drake, and many others. Everyone had a great time. Kass has, in my opinion, one of the finest facilities around. Just about anything needed from complete stations to those hard to get parts can be found at Kass. Thanks to Vince and Al of Kass and

(continued on page 136)

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EDITORIAL BY WAYNE GREEN

SLOW SCAN PROGRAMS

It is one thing to get on the air with slow scan and it is another to come to terms with this new media. You can't use it for very long the same way that you use your phone rig. The problem is the same one that has croppered commercial television – the medium eats up material at a rapid rate.

If you are careful to always make new contacts you have no problem. On the first go round you can get away with sitting there smiling into the camera, flashing your QSL, or a few hastily made posters. From there you can work up some photographs of the wife, children, the shack, house . . . but where do you go from there?

The "professionals" at the game have long since hooked up a good cassette tape recorder to their slow scan system and settled for putting their programs on tapes. As you quickly discover, it will keep you hopping if you have to change flash cards every few frames, swing the camera around and focus it on you or the shack, change your lighting, etc. You will do better to set up your programs similar to the way a television director does the job. Yes, I used to be a TV director, so I can speak with authority.

The first contact should be relatively simple, and consist of a few pictures of you smiling into the camera, a couple of the shack, one of the wife, and a QSL. In practice you'll need two different programs for the first contact, one for working stronger stations and one for weak DX work through QRM. With the weak ones all you really need is a very simple QSL with your call and location on it, probably in big white letters on black.

The second time around you may want to be able to spring something more complicated on your contact. You might do a program showing some of your interests. If you fly, drive an unusual car, have a boat, cameras, or whatever, these are all good grist for the television mill. If you are living in an area of special interest you could shoot some frames showing details about that. Don't forget your kids. You can even hoke up some shots of your baby sitting at the rig or with a mike on a tricycle – you know. The family dog is good for one DX Hound shot.

If you make any trips, keep your slow scan in mind and take some black and white pictures which you can enlarge and put on slow scan tape.

The fact is that there are unlimited possibilities for slow scan programs. I would like to be able to present some of the more interesting ones in the pages of 73. Please get your cameras and cassette recorders set up and, when you come across an interesting program, tape it and send in the pictures so we can pass them along to the readers.

By the way, it is interesting to note that the new slow scan system that has just been announced by Linear Systems (SBE) has a cassette recorder built right into the monitor! This is a logical development. We've been promised one of the new SBE systems and hope to have some interesting news of how it works for you.

The J&R unit has promise too. We did have a chance to try out an early test model for a couple of weeks just before the Dayton Hamvention and were impressed. J&R is making some changes and improvements on the unit and we expect to be able to give you full details and our evaluation before the end of the year. The J&R has a slightly smaller monitor screen than the Robot and there were some slight problems with triggering the vertical scan, but the tuning indicator was most helpful. A good deal of the time you discover a slow scan signal by virtue of the picture being sent and, unless you have a terrific ear or a tuning indicator, you have a tough time getting the picture tuned in right. Once you hear the voice you can zero in just fine, but by then you've missed a lot of pictures.

Most of the slow scan articles so far have been steeped heavily in the technical aspects of the mode. Now that Robot, with SBE and J&R close behind, has reduced much of the technical end to black box (grey, actually) practicality, perhaps we need more information on applications, techniques, use, and such. We certainly do need info on getting the units into tune. It can be most frustrating to the average black box (even if it is grey) user to plug in his camera and monitor only to be told that his contrast or something isn't set right. What to do?

Slow scan is presently limited to the Extra and Advanced segments of the lower bands. Is this a reasonable limitation? Is the use of this new mode part of the reward for getting a higher class license? Is this part of the incentive? Let's have some individual or group out there petition for slow scan on all phone frequencies and see what is what.

The band limitations right now for slow scan are 3.8–3.9, 7.2–7.25, 14.2–14.275, 21.25–21.35, and 28.5–29.7 MHz on the lower bands. All of the phone frequencies above that are open for slow scan. What do you think?

HIGHER POSTAGE

A recent publishing industry magazine revealed that the reason for the postage increases during the last few years has been an end motive of stopping the mail delivery of all magazines and making them be purchased on the newsstands.

When you consider the amount that postage for second class mailing has gone up, this seems not unlikely. It is interesting to note that recent increases have been even steeper than those in the past. The July increase was almost a 50% jump in postage rates for mailing magazines. As near as we can estimate this will make it necessary to increase the yearly subscription rate by a minimum of a dollar – and more probably two! And when you consider that there is no end in sight for this, it is frightening.

The cost of mailing a single issue of 73 has increased over 300% in the few years we have been publishing. Inflation has been serious, but nothing to match that increase.

The post office could, if they wanted, get the cost of handling magazines down to a fraction of today's costs. When you consider the number of magazines that they handle, this is an obvious candidate for automation. Yes, I know that the post office has tried automation and failed miserably – but perhaps magazines could be a different deal.

If the P.O. had a special price for magazines which would fit their automated sorting equipment, the magazines would quickly come around and make the magazines to fit the automation. I should think that something about the size of 73 would go through automatic address readers and sorters quite easily. Larger magazines might tend to bend and fold. Magnetic ink on the addresses would simplify the sorting, allowing machines to decipher the zip codes and speed them in the right directions.

With all magazines the same size, except for thickness, there would be

little difficulty in having the handling of them almost completely automatic. It is people that make for higher costs of handling mail . . . and for slower handling. A magazine sorting machine could zip through thousands of magazines an hour . . . maybe tens of thousands. If the addresses were put on the spine of the magazine they could be "read" and sorted as they moved along.

Unless something like that comes about the post office will eventually be able to force magazines out of business except for newsstand circulation.

EXPO 72

While not the dud of Expo 71, this is still not a hamfest to drag in the troops in quantities. Much of the problems facing the committee running the hamfest this year were the results of gross exaggerations made by last year's committee which resulted in enough resentment on the part of many exhibitors to keep them away in 72.

As an exhibitor in 71 it seemed to me that the 10,000 or was it 50,000 promised was in actuality a few dozen. This year they soft-pedaled the promises and few of the exhibitors were disappointed.

Expo is, by large, an FM affair. A few CB groups turned out to display, but most of those attending were FMers. CQ wisely decided not to support the hamfest this year. Ham Radio was there with a whole bunch of free subscriptions. QST did not support the hamfest either.

One of the most exciting exhibits was the two meter synthesizer at the RP Electronics booth. This gadget had the FMers waving their arms in anticipation. The prototype looked good. It had a numerical readout for the transmitter channel and the receiver was automatically 600 kHz higher. Thus all you had to do was set it for 146.16 and it would receive on 146.76 . . . etc. They are working on a model with separate dials – but since almost all repeaters today are 600 kHz spaced, by the time they get the second unit in production it may not be needed.

General Aviation was there showing off their new transceivers . . . and the pileups around the booth were as heavy as any we saw at the hamfest. Thirty watts and ten channels for only $250 may be a popular combination.

The Clegg 27A, now being delivered at long last, was on display and was a focal point of interest. It was an FM hamfest, for sure. Keith W7DXX and I manned the 73 booth. We took along a 27A for our own use in the rented car, this being a better-than-average solution to the need for a lot of new channels. The Chicago repeater situation is not all that might be hoped – with just one major repeater serving an area with thousands of amateurs. This is not to in any way put down the service provided by WA9ORC – a truly remarkable machine, with ears everywhere and fantastic coverage. But, when you consider that there are about twenty repeaters ready for instant use from Peterborough, the three or four Chicago channels seem scant.

Erickson Communications had an interesting booth, filled with nice Standard radios and Tempo amplifiers. Fred Deeg K6AEH was there from Standard, thus winning the prize for the manufacturer who came the furthest for the hamfest. Jim O'Connell W9JZK, the prexy of Erickson, asked around for a competing two meter amplifier to put alongside the Tempo so customers could see the incredible difference in design and construction between the two . . . he located one which a local amateur was anxious to dump and put it next to the comparable (and lower priced) Tempo amplifier. It wasn't too long before the word got around and the other manufacturer came by for a look. He looked . . . and looked . . . and got red in the face. "How much do you want for that?" he asked. "Oh, forty dollars will take it," said Jim – two twenties were in his hand immediately and off went the amplifier. "Don't you want the screws for the bottom?" called Jim after he stormed off.

One of the interesting items unveiled at Expo was the new Standard tone burst encoder – five channels – and designed to plug right into the back of the 826's. It is designed to mount right under the transceiver, matching it, and the price is about $80.

Another crowd gatherer was the line of rf preamplifiers shown by Crawford Electronics. The 146 MHz unit has been out for some time and has earned a very nice reputation. The new units for 220 and 450 MHz look promising.

Few HT-220 owners have not looked with desire at the very flat touchtone unit which has been available to selected cognoscenti . . they are now coming out for the hoi polloi (us). Waller Electronics in Maryland has a complete unit available for about $55 which mounts on the 220, making it about 1/8" thicker. A larger version is also available for $35 ready to connect to other hand and mobile units . . . $30 in kit form. The very small size of these units is made possible by the use of a flat touchtone pad and a tiny IC to generate the tones. Watch for ads from Waller – and an article in 73.

The little 73 FM Log Books (25¢) sold out almost in minutes when "Ev" Everett of the FCC turned up, smiling. I don't think anyone has ever seen fellows wandering around a hamfest before, making logging motions after every portable contact – and the walkie 2m FM transceivers were everywhere – in great profusion. All you had to do was say "BOO" on 94 and your voice would echo back to you from hundreds of belts.

If the Chicago group keeps up the good work, this event could turn into a major yearly hamfest.

AUTOMATIC ID

The FCC seems to be moving along inexorably toward a system of automatic identification for all transmitters. Though this may be another big step toward Big Brother, still it may have enough advantages to offset any "invasion" of privacy that might bother us.

The basic system is simple – build a miniature IC identification unit into each transmitter so it can be identified whenever it comes on the air. This would be built in by the factory on commercially made gear – would be permanently installed and supposedly tamper-proof. The module would transmit a binary blip every time the transmitter was operated and repeat it every 30 seconds. The whole process would take about 5 milliseconds, so it wouldn't be likely to bother anyone much.

Early estimates are that the identifier might cost about $10 at the manufacturers level, which might add about $30 to the ham price for a rig – but experience with IC costs indicates that competition and mass production would probably cut that substantially, probably not adding more than about $10 at the most to the end price.

Obviously the FCC problems with monitoring the many services it runs herd on will be simplified. Monitoring stations need a computer to catch the identification and compare it with license information in the memory. The problems they have with marine operators, police, business and even CB could be quickly eliminated. Rigs without identifiers could be quickly spotted and put off the air. Illegal CB contacts certainly would stop once identification became instant and positive.

As far as amateur radio is concerned, this could be the ticket to getting rid of the antiquated rule requiring us to log all transmissions. And think how fast contacts could be made if it only took 5 milliseconds to call CQ! And how great it would be to have an immediate identification of

that DXpedition that forgets for hours on end to mention their call.

I can hear it now. "Blip?" "Blip – – blip!" "QSL."

"Blip?"

SSTV in QRM



Most of the slow scan pictures in the magazines have been taken under ideal conditions. The conditions on 14,230 are not invariably ideal. The result is that some of your DX slow scan contacts may be touch and go, with the DX station having to send quite a few frames before one is received that can be deciphered. My first VK contact was through quite a lot of interference and it took about twenty frames before I got one that came through well enough to call it a contact. The picture above shows what happens when the QRM begins to build up on the slow scan channel . . . this was received by K3SLJ from me on Navassa. You can read it, but that's about all.

INCENTIVES

In a recent letter to an amateur Prose Walker of the FCC Amateur Division mentioned that he was taking steps to find out why 95% of the amateurs have not obtained the Extra Class license. I am one of the 95% and perhaps my own reasons are not entirely irrelevant.

The technical aspect of the license exam looks like a breeze. I am sure that with one or two readings of our Extra Class Study Guide that I would have little trouble getting through the written part. But the code is something else.

I do miss not being able to operate on the low end of the 75m band. That was where I used to hang out, looking for DX and keeping in touch with the gang that hangs out in those waters. Once the band was taken away from me I stopped using 75m almost entirely. But I will be damned if the FCC is going to punish me into taking the Extra Class license – and I will continue to resist, even if they force me up to 1200 MHz.

If the FCC had offered me anything at all in the way of an incentive to get an Extra license I probably would have been right in there, but you do not get action from me by whipping me into submission. This was my reason for protesting the whole idea when the ARRL first suggested it – and again when they petitioned the FCC. I want some kind of reward, not just a cessation of punishment.

My interests in amateur radio are wide – very wide. I enjoy FM, repeaters, RTTY, SSTV, DXing, rag chewing, DXpeditions, and so on. One thing that I don't care for is CW. I am quite sure that if CW was voluntary I would be right in there, getting a big kick out of it. But it isn't voluntary at all – it is compulsory, and the result of that is to get my back up again. The technical exam for some reason makes sense to me – I can understand why that is needed to screen out people who want the amateur license. I don't understand what the relevancy of being able to send and receive code has to do with the matter. I have been an amateur for almost 35 years now and have used voice, RTTY and slow scan signals, but my use of code has been minimal – so why should I have to develop a useless skill of 20 wpm code for a higher phone license? Baloney!

You may wish to call me lazy – and I admit that I am lazy – very lazy when it comes to things that are a complete waste of my time and energy. I will work like hell for something that I want and seems reasonable. How many people are basically different about being lazy?

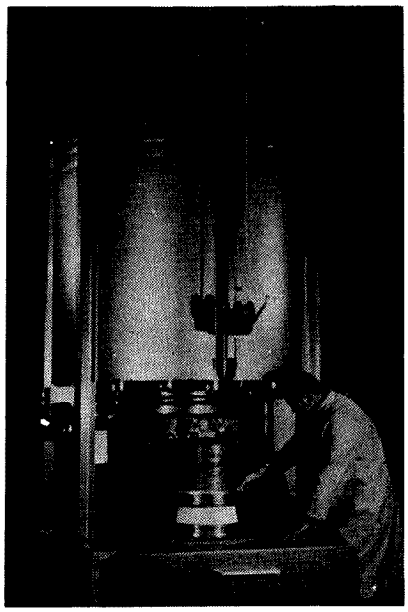
The FCC has turned me off for the time being on 75m and 15m by taking away some of my phone frequencies – but I'm still hanging in there on the other bands. If they come along and dump on me some more I will probably retreat. The psychology is so simple that it is incredible that it is so totally ignored by the FCC – if you want people to go along with you you offer rewards, not punishment.

FM EMERGENCY CHANNEL?

A few of the curmudgeon old timer FMers, inculcated with commercial practices, have been grumbling that repeaters are for emergencies and shouldn't be used for rag chewing. Pish tush and nonsense. If there are enough repeaters in the area to permit rag chewing, then why not? If there are not enough repeaters, how about setting up some more?

There is something to be said about the problem of trying to break in on a pair of inveterate rag chewers. There is a lot to be said. But what is the use of trying to say it when you can't get a word in edgewise? May I suggest an emergency priority input channel? This would allow the gabbers to talk away, repeating themselves as much as they like, pouring forth clichés and trivia, but would still enable the repeater to be used instantly in case of emergency. How about a national panic channel on, say, 145.74 MHz?

A priority channel would certainly be helpful. It would have been nice the other day when I was zipping along the interstate and came across an accident. Sensing the chance to use amateur radio for public service I got a message from the dazed woman who has been driving and wanted her father and husband to know that she and the children were on their way to the hospital. You guessed it, before I could break through on the nearest repeater I was able to phone the message from a gas station. Rats.



WA1KGO Increases Power

Alerted by several ops monitoring the 19–79 repeater that WA1KGQ in Vernon (CT) is stepping up its power in a possible first step of an escalation to take over the 79 channel, the engineering staff on Pack Monadnock swung into two shifts a day to get the new amplifier for KGQ in operation. Here you can see the new final for KGQ being tuned up on 79 by the 73 Technical Editor. Note the nice diplexer built into the plate tank circuit.

SABOTAGE?

One of our readers ran across a weirdie – he bought a piece of surplus which arrived in the original unopened package and, upon close examination, he found that a strategic wire had been cut down deep inside, rendering the unit unworkable. Since the unit had obviously never even been opened by the military, this was a factory "prank." Has anyone else run across anything like this? . . .Wayne

SSTV SCENE

A lot of newcomers have asked about operating procedures and typical picture transmissions. So, first off this month I would like to pass along some ideas to new SSTVers.

Generally most of the gang calls CQ on slow scan for a few frames, interspersed with audio IDs like "K4TWJ calling CQ on Slow Scan TV" a couple of times, then maybe another frame or two of CQ before standing by. This way your video will be noticed if perchance your audio isn't. Pictures you will probably want to record and have ready to transmit often will be pictures of yourself, the XYL, rig (with close-ups of home brew gear) and maybe your city. Plus plenty of IDs. These pictures when recorded on tapes, marked with leader tape as to their content (you can write on paper leader with a ball point pen) make positive transmission of a given picture a snap, while leaving the camera free for candid shots or "instant QSLs" (those menu boards with lettering or blank sheets for the flying spot scanner). Try to briefly explain complex pictures before transmitting them so the other fellow will know who or what you are showing. Then two or three frames of each picture are usually enough for good copy without getting dull. There is usually some of the SSTV group hanging around 14.230 kHz and most of them acknowledge breakers immediately since a group means more pictures and information in a shorter length of time. (And if you are not good friends then, you soon will be).

An item which is just starting to catch on in slow scan popularity is continuous tape loops. W1VRK mentioned this briefly in his recent QST article. Tape loops are ideal for CQs and IDs and are easy to make and use. Just mark a frame of your ID immediately before the vertical pulse (that 1200 Hz "blip") with a grease pencil on the outside of the tape. Let the tape run for 8 seconds (120 lines) and mark it again at the picture bottom (right before the next 1200 Hz vertical pulse). Now splice out the marked frame and splice the frame together to make a loop with the beginning and end of the frame butted together. Drop this loop into the tape recorder, and let the slack just dangle over the side – no spacers, rollers, or reels necessary. Since the end of the frame is spliced to the beginning the loop will play over and over across the tape recorder heads until you stop the tape. Marking the direction of feed and tape content with a grease pen will help if you make up a group of different loops. And hang the loops close by – they'll probably get quite a lot of use.

It is good to see the W7ABW/W7FEN scope adapter in the 1972 ARRL Handbook. This is still one of the least expensive and quickest ways to get on SSTV, and should inspire quite a few to put those old scopes to use as a monitor. Speaking of that, have you noticed how those old scopes are being snapped up at hamfests? It will not be long before scopes are scarce and prices up with the swing to SSTV. (P-7 cathode ray tubes have already started to climb!)

One who is making news with SSTV on 6 meters (and above) is WA1NNW. Ed has worked over 5 states and shooting for WAS/SSTV on six, using a 'scope adapter and W9NTP sampling cameras. He's another one planning SSTV use of the coming satellite. Need Massachusetts on six? Get in touch with him.

Well, I may be taking my life in my hands, but I have another item to pass along this month. Gray scale tapes. These tapes are ideal for setting up and aligning slow scan gear. They consist of 7 shades of gray, and run at 3¾ IPS, 1/2 track. I have approximately 50 of these on 3" reels, and when these run out, I'll cut you a few frames off my 7" reel, and you can splice it into a loop, like I mentioned in the first of this article. Send me a SASE, box, or manila envelope (preferably with a 3" reel of tape inside so I can just swap or dub). If I'm out of the 3" reels I'll return yours and send you some frames to splice into loops.

That's it for this month, be "seeing" you on 14.230.

. . .K4TWJ

* * *

THE COMPLETE SSTV ROSTER?

The chaps at Robot have published their list of slow scanners, and it is a formidable one, with operators in 52 countries listed. Like a repeater list, there is no way to have such a list complete and accurate – even an effort such as the one by Robot is difficult.

It would be nice to be able to publish an up-to-date list of the SSTVers, but I suspect that it would take more time than I could handle. Of course, if there is someone out there who digs slow scan and who is retired or has a lot of time available, perhaps he (or she?) might like to be custodian of The List? Can you ask for a more rewarding and lower paying job?

If someone would like to tackle this list I think that 73 can help. I had in mind asking via 73 for slow scanners to sit down and make a list of all the slow scan stations (two way) that they had worked. Even if only about 10% of the active slow scanners sent in the list the result would contain virtually every active TVer. For that matter, if we got a list of everyone worked by about a half dozen of the most avid scanners we would probably have 99% accuracy. Any takers?

. . .Wayne

* * *

Here are some recently submitted slow scan pictures – all received over the air and photographed from the Robot monitor.



W8YEK has his Polaroid camera ready whenever something unusual pops up on slow scan. Here is a recent picture Gene picked up from a ZS3 in South West Africa.



Postage stamp received by K4PRT. This shows you what can be done with the Nikon 55mm lens.



6Y5GB, George Benson in Jamaica, West Indies . . . photo by K3SLJ.

50 MHz BAND

Bill Turner WAØABI
5 Chestnut Court
St. Peters MO 63376

From most reports band conditions for the June VHF contest were rotten and at first this writer was inclined to agree but after counting all sections worked and heard it really wasn't all that bad. From this area of the midwest openings all though the summer E season were frequent and well distributed as to direction. It seemed that there was a tendency to open an area for a few minutes, close suddenly, only to open to an entirely different area moments later. On the air conversations and correspondence with numerous observers from Maine to Arizona and British Columbia to Puerto Rico indicate similar conditions to have prevailed over most of the country. There was naturally exceptions to the rule but the hours long openings to one area of years past were in general few and far between. Openings to the Pacific Northwest seemed more frequent than in recent years. Several years back the writer spent the better part of three summers attempting to work Oregon for number 48, finally working K7RWT. This year Dave was worked on three occasions and other contacts in Oregon, Washington and British Columbia were commonplace. WA7UBI was a very popular Idaho station, contacts being reported by many. K6TYW/7 was also busy passing out Idaho to the many who need it.

W4GDS says he received numerous VP5RS QSL's without an SASE, these will not be answered until the sender provides one. Bob, Joe and Hoppy made over 1000 contacts on 6 meters and 2500 on HF during their brief stay on Caicos, the cost of postage alone on this many cards is staggering, not to mention the writer's cramp involved in addressing that many cards. If you forgot to do your part, do it now if you want confirmation of this rare one.

WA1EXN reports the VE1ASJ DXpedition to Prince Edward Island didn't get off the ground due to rig problems the previous night. Hopefully Andy's second try in late July was more successful. Art also reports K7ZOK is waiting for confirmation of a New Hampshire contact with WA1GCU to complete his second WAS on 50 MHz. He already has one from previous activity in Zero land. This must be a first.

Dick, WB8GZL, told me the other evening about the Ohio 6 meter net. This group meets on 50.160 at 0100 every evening. Monday through Saturday, the net is called from Dayton; Dick is net control from Waverly on Sunday. There are an average of 25 or so check-ins from 4 or 5 states. Calls are made in all directions and additional check-ins are solicited.

Several months ago in this column, assistance was offered to anyone having a problem with equipment, TVI, getting on the air or whatever. I enjoyed hearing from many of you and trust the answers and references supplied were helpful. The offer still stands and will as long as time is available. There are only two criteria: the problem must concern 6 meters and an SASE must be enclosed. It would be helpful if as much information as possible is included. Brand of rig, schematic diagram (or the source of same if it is home brew equipment), details of what happens (or doesn't happen), are often left out requiring further correspondence and unnecessary delay.

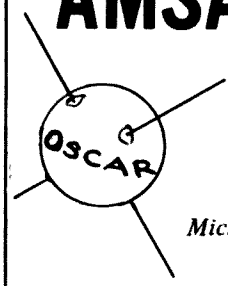
In connection with the above, the answer to one question already asked several times is as follows. Frequency instability in early Swan 250's may usually be cured by one or both of the following. Do not operate the rig in close proximity to an open window, air conditioner, or fan. Cover the "frequency range megacycle" capacitor with a cardboard box or a plastic sandwich bag. Either, when taped to the chassis around the edges, will prevent airflow across the capacitor and the associated drift in frequency. Another problem common to this rig is instability in the carrier null setting. The best fix I know of is to replace the carrier null potentiometer with the best grade composition pot you can find. The Ohmite type AB or the Allen-Bradley type J are recommended.

Response to a previous request for source material for this column was quite good but there remain areas from which no response has been received. Active and knowledgeable hams are a very necessary part of a 6 meter column, conditions and activity vary widely from one area to another and only through reports from YOUR area can the condition of our favorite hobby be accurately evaluated. Drop me a card and I'll explain what is needed and the time factor.

The ARRL has announced a new (3rd) edition of the VHF Handbook, it has not however appeared on the shelves of the local ham emporium. A new (19th) edition of the Editors and Engineers Radio Handbook is also due shortly. Both of these volumes are required reading for any serious 6 meter ham.

WAØABI

AMSAT NEWS



Michael Frye WB8LBP
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Dayton OH 45429

Rescheduling of A-O-C Launch

A shuffling and rescheduling of Delta launch vehicles by NASA has caused a four-month delay in the launch of the OSCAR-6 (A-O-C) satellite. The launch of the ITOS-C meterological satellite has been cancelled, and NASA has decided to launch ITOS D (on which A-O-C was to piggyback) with the ITOS-C launch vehicle. Unfortunately, the ITOS-C booster does not have sufficient payload margin to allow OSCAR-6 to be launched with the ITOS-D. NASA has therefore rescheduled our satellite as a secondary payload on the NIMBUS-E meterological mission presently scheduled for launch in November of this year, pending approval of the NIMBUS project office. A-O-C is now expected to be placed in a 690 statute mile circular polar orbit with a period of 108 minutes and an inclination of 99.9 degrees. A sun synchronous orbit is planned with overhead passes expected around local noon and midnight each day.

Reprinted from AMSAT newsletter

This delay mentioned above will allow time for AMSAT to mold together a lot of projects it is currently involved in. Such things as a workable communications network to broadcast information direct from the launch site to amateurs all over the world. In addition AMSAT still needs volunteers to complete its ground command network. After the launch, amateurs are needed that will perform day after day. With the dependability of a net worker, to copy down the data from the telemetry unit and send it to AMSAT.

Another interesting note is that the FCC has approved the waivers sent to them by AMSAT. That is, in addition to other allowances, novices and technician class licensees can operate through the two-to-ten repeater on board A-O-C. This will allow a lot of newcomers to the field to participate in this exciting project.

Please send questions, comments, etc. as I would like to know how this column is being received.

WB8LBP



The Golden Jubilee Hamfest of the Northern Alberta Radio Club is all set for the 16th and 17th of September 1972. The event will take place in the Silver Slipper Saloon on the Edmonton Exhibition grounds. Pre-registration, at $9.00 per person will be accepted until August 15th. Regular registration, which will begin at the Hamfest site on the evening of Friday, September 15 will be at the rate of $10.00 per person. Children's admission to the Sunday morning breakfast in the park will be $1.00 per child.

All those attending will have a chance at valuable prizes. Also, there'll be technical and social events, bunny hunts, and other technical contests, a banquet and a casino in the saloon.

Bring along the kiddies and the XYL. You can park your trailer right nearby if you wish. There'll be special events and prizes for the ladies.

Listen on 80, 40, 20, 15, and 10, and on 2 meters for VA6NC, the special Hamfest station. We'll have special QSLs for all contacts.

* * *

The Peoria Area Amateur Radio Club, Inc. will hold its 15th annual Hamfest Sunday, September 17, 1972 at Exposition Gardens (same place as last year), located on the northwest edge of Peoria, IL. Lunch will be available. There will be plenty of activities for the entire family, beginning with the campsite opening the preceding evening and the banquet Saturday, Sept. 16 at V Junction, $5.50 per person. Door prizes for men and women, cocktail hour 5:30 to 6:30, dinner 6:40. Two motels within walking distance. Free coffee and donuts from 9:00 to 9:30 AM CDT.

Free swap section, parking, contests, cartoons for kiddies and of course the many eyeball QSO's. Advance registration $1.50, at gate $2.00. For further details and advance registration for banquet or Hamfest tickets write Wendell McWilliams, WN9DVJ, Box 1, Rome, IL 61562.

* * *

VK/ZL OCEANIA DX CONTEST 1972

WIA and NZART invite all amateurs to participate in the 1972 VK/ZL/O DX Contest. The usual contest rules apply, while the following is a summary of the important facts, condensed to aid publicity.

1. When – Phone: 24 hours from 1000gmt Saturday 7 October to 1000gmt Sunday 8 October.

2. CW: 24 hours from 1000gmt Saturday 14 October to 1000gmt Sunday 15 October.

3. Scoring: For Oceania Stations other than VK/ZL: 2 points for each qso on a specific band with VK/ZL; 1 point for each qso on a specific band with the rest of the world. For Rest of World other than VK/ZL: 2 points for each qso on a specific band with VK/ZL; 1 point for each qso on a specific band with Oceania stations other than VK/ZL.

4. Final Score: is derived by multiplying total qso points by the sum of VK/ZL call areas worked on all bands. (The same VK/ZL call area worked on different bands counts as a separate mult).

5. Serial Numbers: Will consist of five or six figures made up of the RS(T) report plus three figures which should commence with 001 and increase by one for each successive qso – 002, 003, etc.

6. Logs: (a) Must show in this order: Date, time in GMT; call sign of station contacted; band; serial number sent; serial received. Underline each new VK/ZL call area contacted and make separate log for each band used. (b) Summary sheet to show call sign; name and address (use block letters please); details of equipment used; and for Each Band, qso points for that band and VK/ZL call areas worked on that band. "All Band" score will be total qso points multiplied by sum of VK/ZL call areas on all bands while "Single Band" scores will be that band's qso points multiplied by VK/ZL call areas worked on that band. **Sign a declaration that all rules and regulations have been observed.

7. The usual attractive certificates will be awarded to each country (Call Area in W/K, JA/JH etc.) on the following basis: (a) Top Scorer using "all bands" (b) Separate awards for phone and CW and (c) Other certificates will be awarded (e.g. 2nd/3rd and separate bands awards depending on conditions and activity).

Listeners' Section to count for points, a VK or ZL station ONLY must be heard in a qso and the following details noted in the log – date, time in gmt, call of the ZL or VK station heard, call sign of the station he is working, RS(T) of the VK/ZL station heard, serial number sent by the VK/ZL station heard, band, points. Scoring is on the same basis as for the transmitting section and the summary sheet should be similarly set out.

All logs should be posted to reach: NZART CONTEST MANAGER, Box 489, Wellington, N.Z. or NZART CONTEST MANAGER, 152 Lytton Rd. Gisborne, N.Z. before 25 January 1973.

* * *

VE2CWR amateur station exhibition at Fairview Shopping Plaza, off Trans Canada Highway, Exit 33, Montreal, Canada – August 31 to September 9. Active stations on 80, 20 CW & SSB and 2m FM (146.94 and area repeaters) many displays – antique radios, VHF equipment, SSTV, etc. Special QSL information VE2CWR, 108 Florida Drive, Beaconsfield 880, Quebec, Canada.

* * *

The ILLINOIS REPEATER COUNCIL proudly announces its birth. Your Repeater Organization is needed to help us grow. Tell your President, or Trustee to contact: Ray Thill WA9EXP, P.O. Box 455, Arlington Heights, IL 60006, or call: 312-253-2058. The IRC is currently composed of member repeater and remote base organizations representing over fifteen hundred FM'ers. Membership is open to any such organization operating in the state. The next meeting will be August 17, 1972. Call or write for details.

* * *

KENTUCKY HAMFEST. The Greater Louisville Hamfest will be held August 27, 8 AM to 5 PM at Pine Grove, Otter Creek Park, S.R. 1638 off U.S. 31W near Fort Knox. Registration is $1.00, Fleamarket, $1.00, Door Prizes, Food, Picnic Tables, Auction, Ladies Program. Contact: Guy Partridge, K4KZH, 8276 Walker Rd. Louisville KY 40258.

* * *

An Operating Achievement Award Certificate signed by Governor Daniel J. Evans will be offered by the Puget Sound Council of Amateur Radio Clubs for contacts made during Washington State Amateur Radio Week, September 9th through 17th. For further information write to The Puget Sound Council of Amateur Radio Clubs, 12306 80th Avenue, East Puyallup, Washington, 98371.

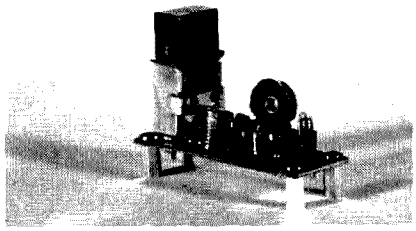
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18TH. ANNUAL VHF CONFERENCE at Western Michigan University, Kalamazoo, Michigan will be held October 21, 1972 (Saturday). Flea market, speaker from AMSAT, etc. For full details write: VHF Conference, PO Box 934, Battle Creek, Michigan 49016.

NEW PRODUCTS

SUB-AUDIBLE TONE ENCODER

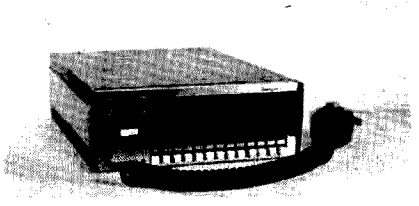
The Communications Specialists continuous tone encoder is a wee one, about 2½" long, 7/8" wide and 1¾" high. It uses the resonant reed made by Motorola or Bramco to determine the exact frequency. The oscillator will operate over the range from 67 to 3000 Hz.



The unit pictured has a Motorola 4A reed plugged in, resulting in a continuous 141.3 Hz tone being generated. There are a few repeaters that are turned on by this type of tone instead of the more ordinary carrier operated system. These are listed in the Atlas with a "PL" or "PL4A." If you run up against a PL type of repeater without knowing it, frustration can set in rapidly. You can hear fellows talking with each other over the repeater even though you cannot break through. These are in use by some repeaters who wish to be more exclusive than others such as WA2UZE on Long Island and WA2UWR in New Jersey. PL stands for Private Line, a Motorola patent and trade marked term.

The above encoder costs $14.95 wired and tested from *Communications Specialists, Box 153, Brea CA 92621.* The reed is an extra $17.50. The connections are simple – 12 volts and one audio wire. The unit is small enough to fit inside of just about any FM transceiver made.

SIMPSON MODEL B FM TRANSCEIVER



How about a 12 channel two meter FM transceiver with a full 25 watts output? The Simpson Model B has been getting rave notices in the VHF marine field, but has not been formally introduced to the amateur market yet.

The Model B Simpson uses the same boards as the well known Model A – and beauties they are, too – plus a 25 watt transistor power amplifier. No tube here, this is all solid state power. The receiver output goes into a front speaker with two full watts of audio power so you can turn up the volume control and hear this speaker clearly and without distortion even in a tractor. It's designed to be heard over the roar of a boat engine. The front speaker is a great advantage as the sound from the big oval speaker comes straight out at you, not via the floor of the car or from under the dashboard.

In the low power position the rig puts out one watt – which is handy now and then. The 25 watts will help your signal to go over hills, around buildings, and generally get into the repeater a whole lot more than the lower powered transceivers will.

The instruction manual is a marvel of clarity – complete with blown up layouts of the circuit boards which show the profusion of test points and clue you into the schematic diagram. This manual is put together for a technician, not an appliance operator.

The price for this gem – about $300 – how can they do it? By selling direct and cutting down the normal markup substantially.

Note that they have not skimped in the area that several manufacturers have: trimmers for the receiver. The fact is that most crystals will not hit the receive frequency exactly and if your receiver is at all sharp the chances are very good that you will be listening off to one side of the repeater. This rig has trimming capacitors on both the transmit and receiver crystals – and not those inexpensive compression types either, these are miniature (and expensive) air padders! Each one has a plastic shield so you won't bend it when you stab it with a screw driver and miss the first time or two. This is just typical of the attention that Simpson has lavished on this rig.

The amateur who has any enthusiasm for getting into a rig and modifying it can have a ball with the Model B. With a little prodding it might be possible to buy an extra oscillator board from Simpson which provides a second set of twelve push buttons. This can be mounted immediately under the present board, giving you a 24 channel transceiver. At least one such modification has been made, so this is not pure conjecture.

The enterprising amateur interested in whomping up a repeater could do a lot worse than start with the Model B. Indeed, one commercial firm has done exactly that, though they apparently have run into some difficulties doing this in production quantities, judging from the complaints. Nevertheless, the B boards are suitable for such a modification, the transmitter being on one side of a completely shielded box and the receiver on the other. Even the little 25 watt amplifier is in its own box, connected by coax cable, complete with a plug in the cable.

It is unlikely that any article submitted to *73* on modifying the Model B (or, indeed, the Model A, which is very similar to the B, but runs a mere ten watts) for repeater use would be given short shrift. *Simpson Electronics, Inc., 2295 NW 14th St., Miami FL 33125.*

GENAVE 2m FM TRANSCEIVER

The General Aviation GRX-2 FM transceiver will have some of the other manufacturers getting a little on edge. Here is a ten channel push button rig that is solid state and has a full 30 watts output!

The size is small – only 2½ x 6½ x 10" deep. It should fit just about anywhere in the car – and that 30 watts should get the user into the repeater, even if the repeater has a bigger mouth than ears – which many have.

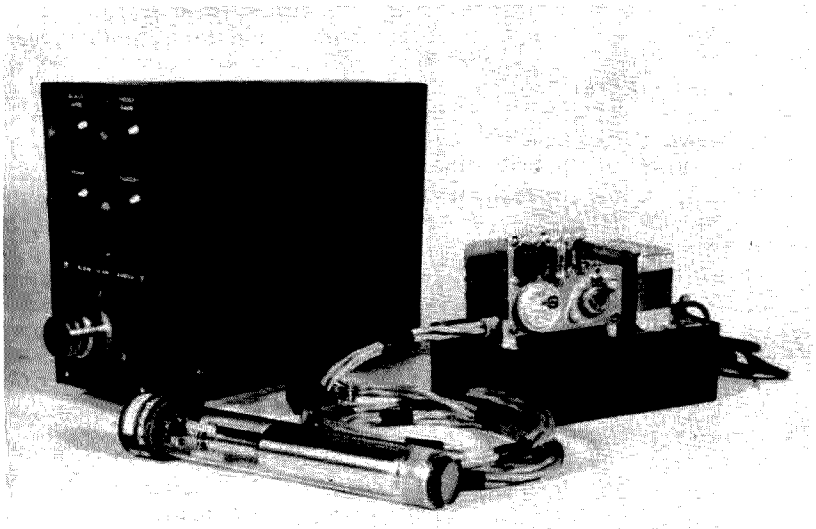
The layout is clean. The bottom is wave soldered so there is little chance that parts are going to be cold soldered or break loose. The trimming capacitors are right out there in the open where you can get at them easily to tweak onto channel. The high-low-off power switch is a nice deal in that you don't have to lose your volume setting every time you turn off the rig. It gets to be a bother to have to turn off the squelch and adjust the volume every time you turn on a rig. Hooray for a separate power switch. The low power position is handy for saving your car battery or for use if you decide to make a shoulder portable out of this unit with a few rechargeable nicads.

The mike plugs into the side of the rig, which many seem to prefer now to front jacks. It does keep it out of the way. This rig is so clean inside that even a rank amateur (pardon the term) would have no problem in moving the mike jack to the back of the rig, if he wanted. The chap who likes to fool around and add things will have a ball with this transceiver – for despite its small size, there is all sorts of room inside to play

The loudspeaker is immense for a wee transceiver, four inches in diameter, and the audio power is there to push it – 1.5 watts! They don't have a jack to feed this to the car radio speaker, but it shouldn't take you ten minutes to put one in. There is plenty of room on the back of the rig to drill

(Continued on page 106)

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Construction of a PLUMBICON SSTV Camera

Introduction

The use of fast scan vidicons in slow scan TV cameras was described by Taggart in *QST* for December, 1968 and by Hutton in *73* Magazine for February, 1969. Several amateurs have experimented with fast scan vidicons in SSTV camera circuits but the overall results have not been as good as expected. The problem is one of dark current, i.e. the inability of the vidicon's target to discharge properly when scanned at slow rates causing a picture to be gray and white, not black and white. The resulting pictures do not have the full range of gray scales as those generated with a flying spot scanner or a 7290 vidicon slow scan TV camera. The only sucessful use of a fast scan vidicon in the slow scan mode has been in the sampler type of operation as described by Stone in *Ham Radio* for July, 1971, or by Miller in *CQ* for August, 1969.

A new camera tube suitable for use in amateur SSTV cameras has appeared on the scene and is called a Plumbicon[1]. This tube was developed in Europe by The Phillips Company and is used in many color TV cameras in this country. The first use of this tube in a SSTV camera known to me is by Art Backman SMØBUO and was briefly described in *ATA International* for May 1969. Bob Taylor W4YHC was able to acquire several of these tubes and I, along with several other SSTV experimenters, have been building cameras using the Plumbicon. The camera described in this article is the results of experiments carried on by Bill Briles W7ABW and me. The pictures produced by this camera are of the same quality as that produced by a 7290 vidicon equipped SSTV camera. The construction is very straightforward and the adjustment is no more critical than for any vidicon equipped camera.

1. Plumbicon is a registered trademark of the North American Phillips Company.

How It Works

In the camera block diagram, the vertical oscillator and amplifier is used to generate a sweep voltage at 1/8 Hz to deflect the

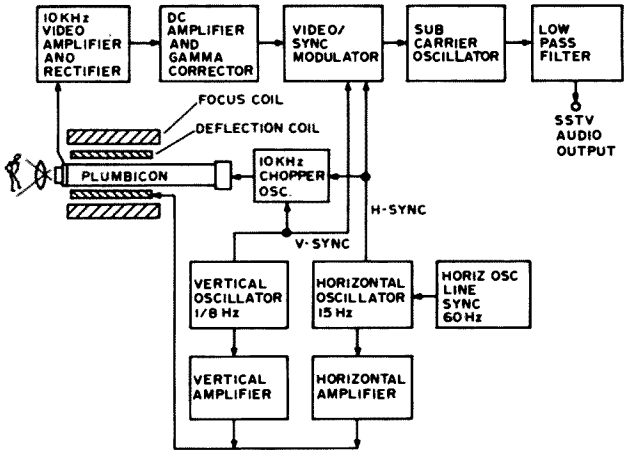


Fig. 1. Block diagram.

electron beam in the Plumbicon vertically. The horizontal oscillator which is synchronized to the 60 Hz power line is amplified in the horizontal amplifier and is used to deflect the electron beam in the horizontal direction at 15 Hz. This deflection will generate a scanning raster on the back side of the camera tube target of 200 lines in 8 seconds. The electron beam is chopped at a 10 kHz rate by the sync keyed 10 kHz oscillator.

The target voltage appearing at the output of the Plumbicon is an ac signal which is amplified in a two stage amplifier. The output of the "video" amplifier is rectified and the signal is then amplified in a dc amplifier whose response is controlled by a Gamma corrector. This is done to correct the response of the camera tube to that more like the human eye. (Similar to the standard vidicon response). The amplified dc signal is fed to the video/sync modulator where the polarity of the video signal will cause the subcarrier oscillator to swing anywhere between black (1500 Hz) and white (2300 Hz) depending upon the picture content. Vertical and horizontal sync pulses are sent from the sweep oscillators to the video/sync modulator which causes the subcarrier oscillator to swing down to 1200 Hz during the presence of either a vertical or horizontal sync pulse. The square wave output of the subcarrier oscillator (a free running multivibrator) is filtered in the output and the SSTV audio signal is now ready for transmitting over the air on a SSB transmitter, monitoring, or recording on a tape recorder.

Construction

The camera shown in the photographs is the second version constructed. The first

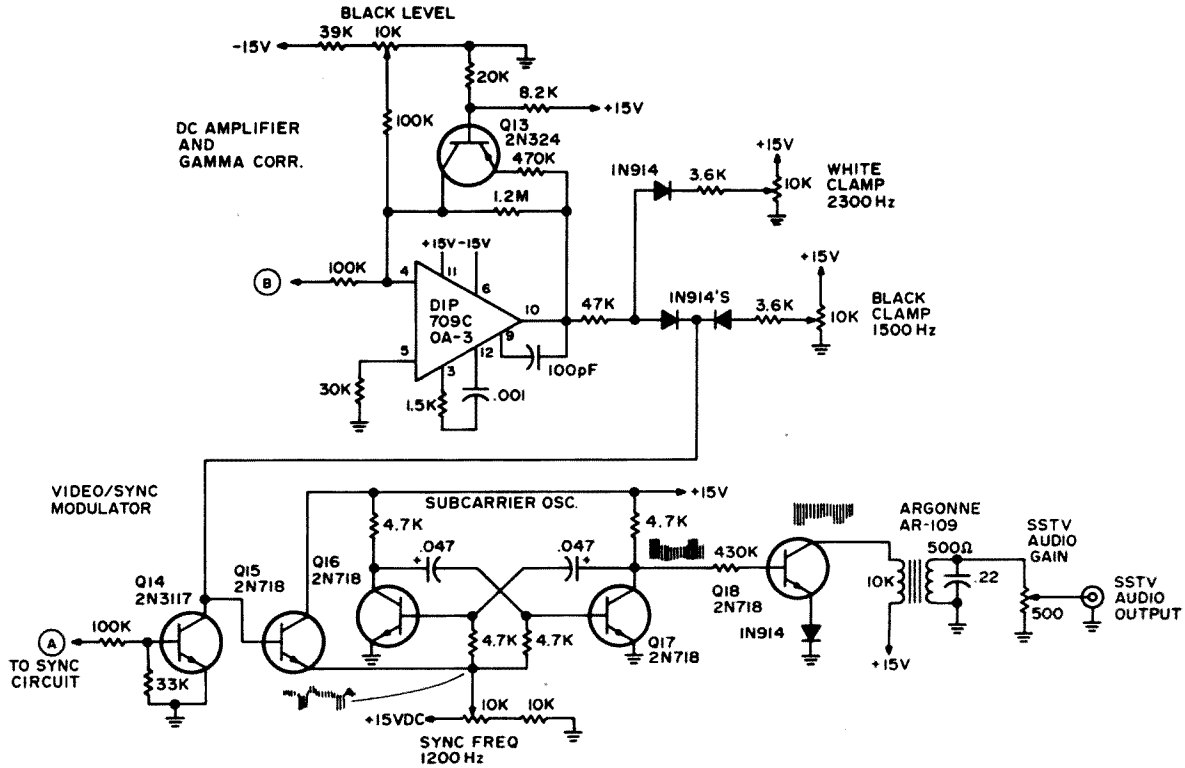
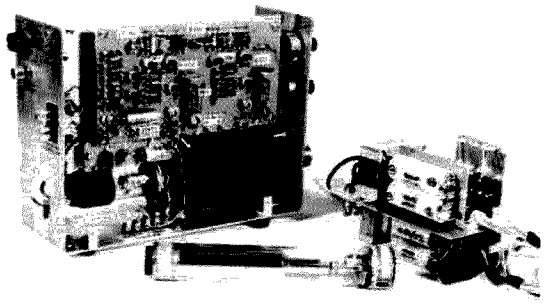


Fig. 2. Schematic (Part 1).



Innards of Plumbicon camera.

model had an integral power supply, but it gave nothing but trouble from its strong magnetic field. Extensive shielding of the transformer compartment with conetic material failed to reduce the interference to an acceptable level. The Plumbicon is very susceptible to stray magnetic fields which show up in the monitor as vertical stripes. The power supply was moved to a separate chassis and the camera rebuilt. It then produced excellent hum-free pictures. The camera electronics assembly is 3½" wide by 7½" high by 9¾" deep. The power supply is built on a plastic instrument case 3¾" wide by 2" high by 6¼' deep. Power from the unit to the camera head is provided by a multi-wide cable and a Jones plug at the camera head rear panel.

The electronics for the camera was assembled on perfboards using push pins. The 10 kHz chopper oscillator and video amplifier should be assembled in shielded boxes as shown in the photographs. The boxes were made from galvanized tin and are 3¾" wide by 4¼" deep by 1¼" high for the video amplifier, and 1¼" wide by 4¼" deep by 1¼" high for the 10 kHz chopper oscillator box. The 10 kHz chopper oscillator, the video amplifier, the dc amplifier and gamma corrector, the subcarrier oscillator, the video and sync modulator, and the SSTV audio output stage are mounted on one side of the camera. On the other side of the unit, the circuit board containing the 60 Hz line sync, vertical and horizontal sweep oscillators and amplifiers, the magnetic and electrostatic focus circuit are mounted.

Sockets for Plumbicons are usually difficult to locate, so one was easily made from an old octal socket, by drilling out the center to pass the glass seal on the base of the camera tube and also, drilling out one of the socket pins for the alignment pin.

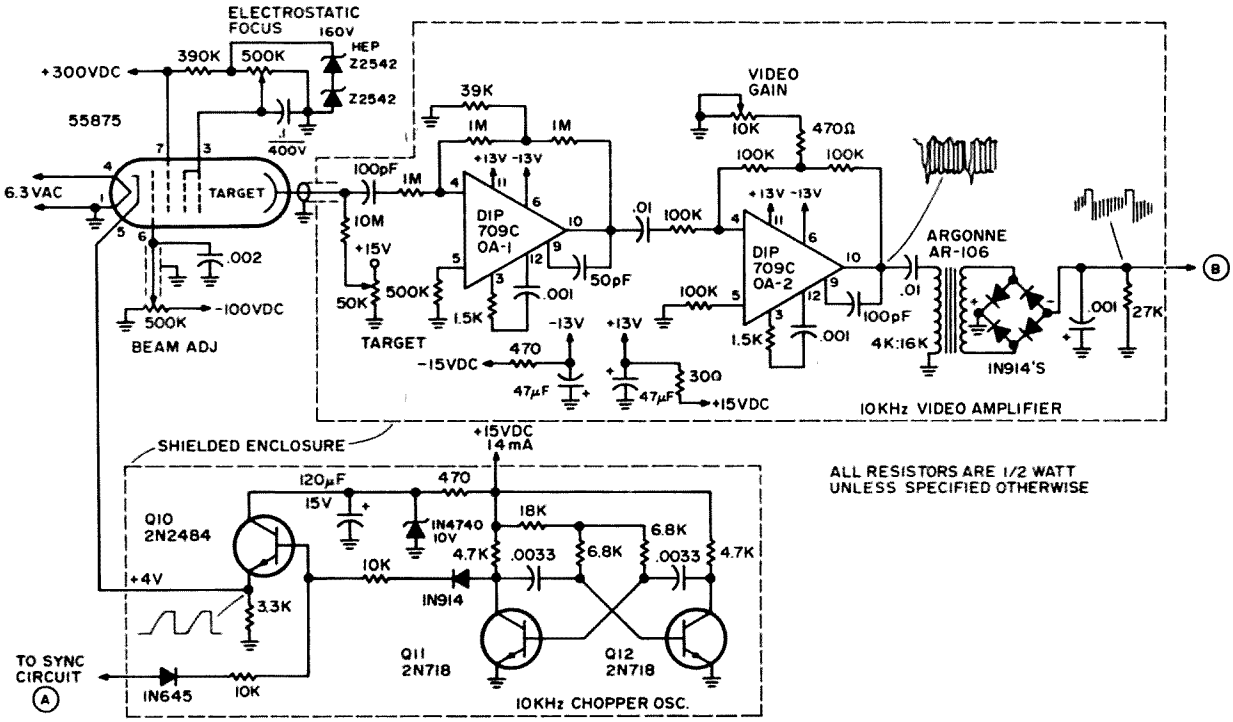
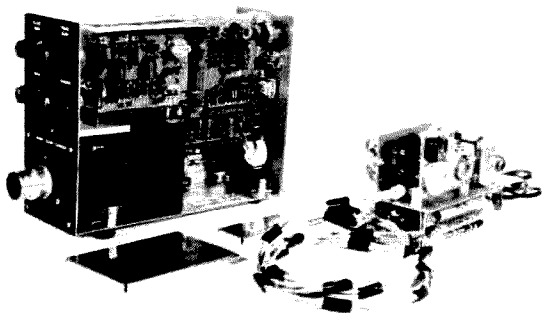


Fig. 3. Schematic (Part 2).



Plumbicon camera with video amplifier and 10 kHz chopper oscillator exposed.

The Plumbicon deflection yoke and focus coil were handmade, as there are no kits for this type of assembly. Information on the techniques of making camera tube deflection components may be found in *ATV Anthology* available from *73* Magazine. The focus coil form was made from a cardboard mailing tube 4½" long with an inside diameter of 2". The focus coil plywood end bells are 3-1/8" by 3-1/8" by 1/4" thick, and are glued over the ends of the cardboard tube making the coil winding area 3¾" long. This form was wound with approximately 5000 turns of number 32 wire. The dc resistance was around 400 plus 50 or minus 100 ohms.

Due to the lower vertical and horizontal sweep frequencies used in SSTV, the deflection coils will contain more turns of wire than those used in fast scan TV. The deflection coil window form was 1½" by 3/4" by .050" thick. Each vertical coil has approximately 620 turns of #36 wire. Each horizontal coil has approximately 800 turns of #36 wire. The series dc resistance of the two vertical deflection coils is 320 plus or minus 20 ohms and the resistance of the two horizontal coils in series is 220 plus or minus 20 ohms. The important thing is that each pair of coils be matched in individual resistance (same number of turns) or you will have unequal deflection in that particular plane. The Plumbicon is a bit larger in both diameter and length than the standard vidicon and will require a deflection coil form with an inside diameter of approximately 1¼". Such a form may be found inside a box of plastic sandwich bags, and should be cut to a length of around 5 inches. Install the Faraday shield, and deflection coils on the form as per the procedures in the *ATV*

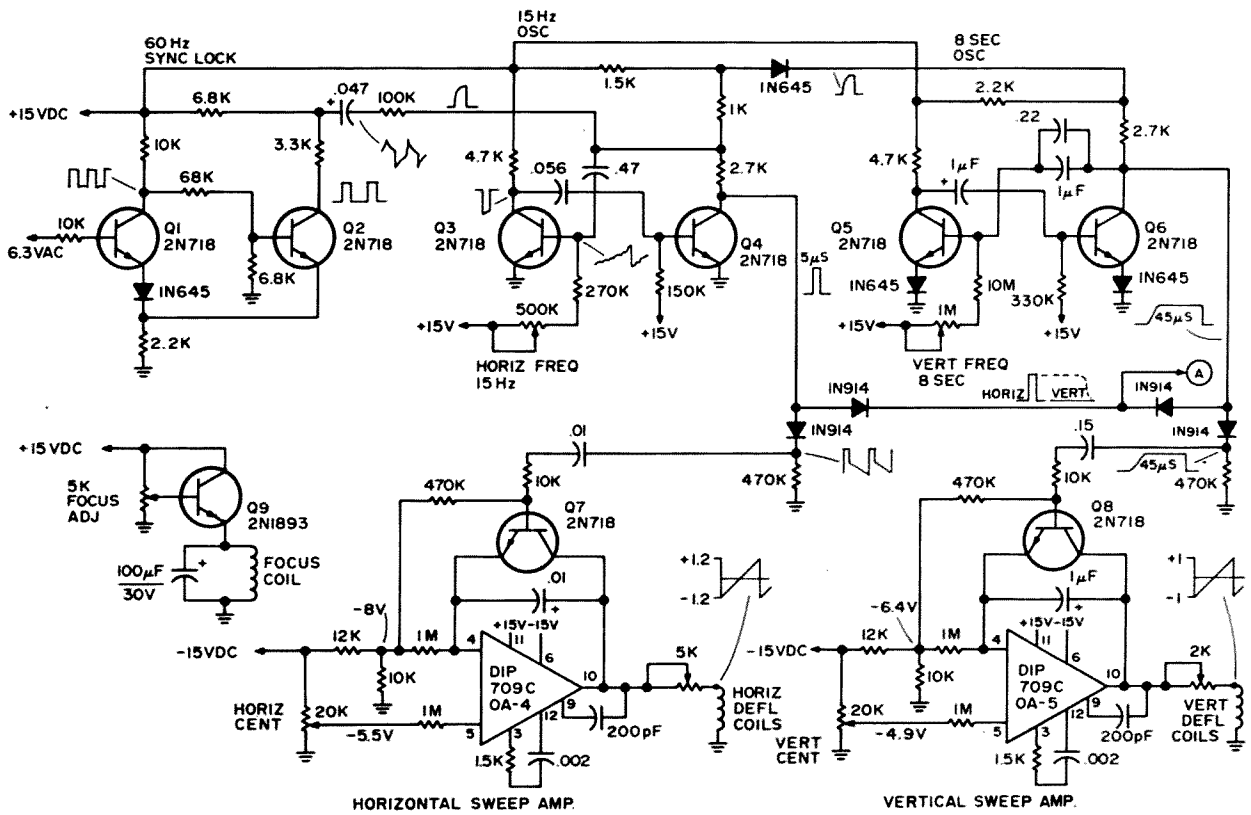


Fig. 4. Schematic (Part 3).

Anthology. Watch out when you phase those coils as I connected my vertical coils out of phase and had no vertical deflection when the camera was first tested. (I had built over a half dozen of these vidicon deflection assemblies and became over- confident!)

The lens of this camera was salvaged from a surplus gun camera. It is of 25mm FL and required a spacer of about 3/8" between the front of the focus coil assembly and the back of the front panel. The exact spacer required for each camera will depend upon the lens used and its focal length.

Camera Adjustment

It is a good idea to check out the various circuits of the camera before plugging in the camera tube. Using a dc oscilloscope, check for proper wave forms and voltages at the junction of the two resistors in the collector of Q-2. This is to confirm that the 60 Hz lock-in pulses are being generated. Observe the output of Q-4 and adjust the Horizontal Frequency Control to 15 Hz. While monitoring the output of Q-6, adjust the Vertical Frequency Control to one pulse every 8 seconds. I use a stop watch to check the timing of the vertical oscillator. Now move over to the output of the horizontal sweep amplifier and set the Horizontal Size and Centering Controls to obtain the deflection voltage and wave shape as shown on the diagram. Repeat the same procedure for the output of the vertical amplifier.

Check the output of the 10 kHz chopper oscillator by monitoring the output at the emitter of Q-10, or pin 5 of the camera tube socket. To adjust the subcarrier for proper operation, connect a jumper between the collector and emitter of the sync modulator Q-14 and adjust the Sync Frequency Control for 1200 Hz as monitored at the SSTV audio output connector. Remove the jumper and adjust the White Clamp Control so that the wiper is at the 15 volt end. Remove the dc amplifier OA-3 and adjust the Black Clamp Control for 1500 Hz as monitored at the SSTV audio output connector. Reinstall OA-3 and adjust the Black Level Control to about 2/3 of its control rotation toward the minus 15 volt end. Now adjust the White Clamp Control for 2300 Hz as monitored at the SSTV audio output connector. Adjust

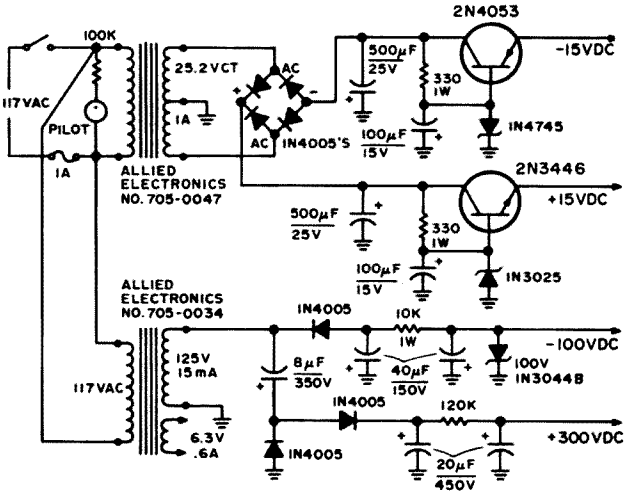


Fig. 5. Power supply unit.

the Black Level Control back to a point where the SSTV audio output is 1500 Hz.

Turn off the power now, and install the socket on the camera tube. The following table is a list of the control settings and voltages at critical points as found in the K7YZZ SSTV camera. They will provide the builder with a good starting point when beginning final tests and adjustments.

Beam	-41.5V
Target	+15V
Electrostatic Focus	+62V
Magnetic Focus	+5.3V
Black Level	-.40V
White Clamp	+4.8V
Black Clamp	+3.8V
Sync Freq	+3.0V

It should be noted that there is interaction between the optical focus, electrostatic focus, and magnetic focus in the process of getting the sharpest and best quality picture from the camera. For portrait work I use a black cloth background and a couple of Sylvania Soft White 40 watt bulbs in reflectors to illuminate the subject. The Soft White light seems to have the best output for the Plumbicon tube. I spent around two weeks experimenting with the controls and lighting, learning how each one affected the camera operation. The thing with slow scan cameras is to not get in a hurry but take your time and the end results will be very gratifying.

I wish to thank Bob Taylor W4YHC and Bill Briles W7ABW for their help during the construction and testing of this camera.

. . .K7YZZ

Ernest P. Manly W7LHL
429 10th Avenue
Kirkland WA 98033

WWVB 60 kHz FREQUENCY COMPARATOR RECEIVER

This system uses a heterodyning and intergration process to display the error between WWVB at 60 kHz received frequency and a local frequency standard on a linear phase versus time plot. Before describing the theory of the system there were certain design criteria requirements.

1. Low cost ($50) exclusive of recording system.
2. Straightforward construction and no critical circuit adjustments.
3. Resolution to 1 part in 10^{10}.
4. All solid state using readily available RTL IC devices.

Introduction

Many frequency control system applications dictate the use of secondary frequency standards sharacterized by fractional frequency stability better than a few parts in 10^8. Instrumentation packages which employ internal secondary frequency standards include digital counters, frequency synthesizers and communication equipment. Low cost frequency standards and most instrument packages employ a quartz-crystal controlled oscillator having stabilities better than a few parts in 10^8.

All secondary frequency standards exhibit frequency drift characteristics which, over a period of time, result in cumulative frequency errors. The term "aging rate" is used to describe the time rate of change of the oscillator frequency. For quartz-crystal standards the aging rate itself is a variable which tends to decrease in magnitude with time (when the oscillator is operated continuously without interuption of power). Practical means for calibrating secondary frequency control devices against reliable sources of known frequency (primary standards) are required in order to maintain reasonable limits of output frequency uncertainty.

HF and LF Propagation

The hf transmissions from the National Bureau of Standards (NBS) stations WWV and WWVH are radiated at precisely known frequencies: however, due to the relative instability of hf propagation, variations of a millisecond or more in path delay are experienced. Changes in path delay in turn cause apparent received carrier frequency fluctuations. These effects cause measurements of the hf carrier frequency, or of the time-tick modulation period, to become very time consuming. Resolution of a part in 10^9 requires about two weeks.

The lf transmissions from NBS station WWVB at 60 kHz are far more stable because the signal is propagated as if it were in a waveguide (i.e. the surface of the earth and the lower regions of the ionosphere forming the wave guide). Since the ionosphere acts as a boundary rather than as a direct reflector, its variations have a much reduced influence. Variations in propagation conditions due to the ionosphere do, however, exist and techniques are available for

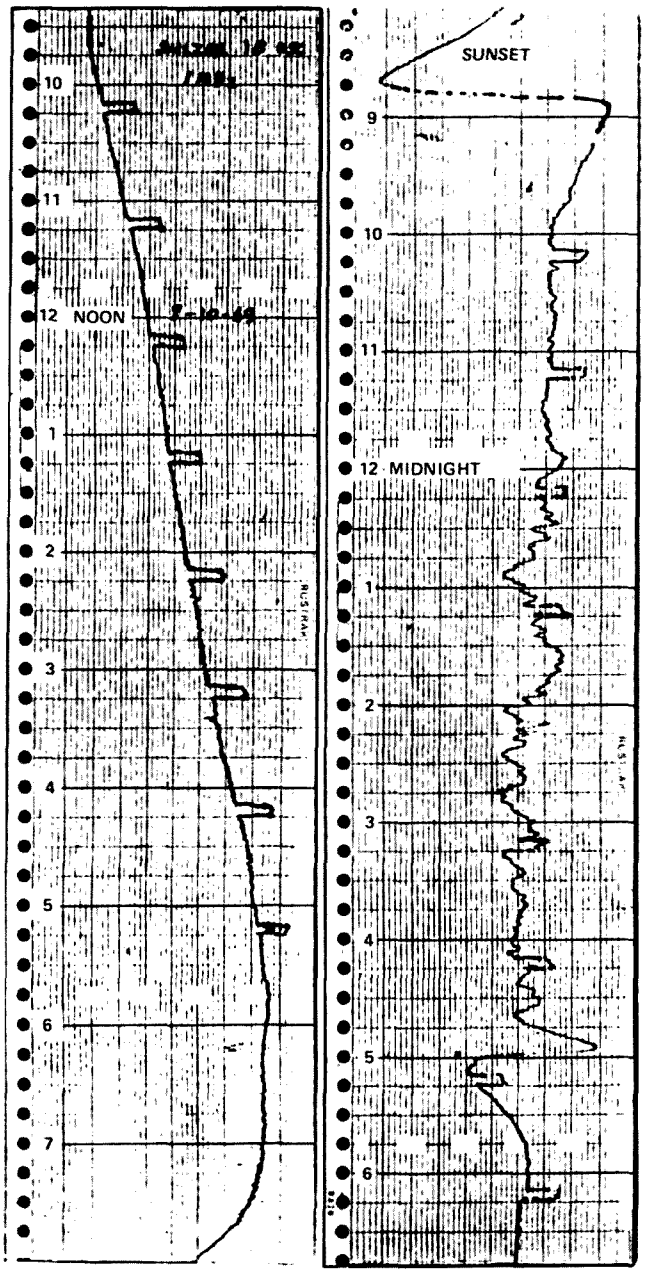


Fig. 1. Chart recordings.

working around them. Factors affecting path phase velocity include ionospheric conditions (diurnal shift-phase shifts occurring at sunrise and sunset), ground conductivity, and surface roughness. Since the phase velocity of long range lf signals depends to an extent upon the effective height of the ionsphere, sudden atmospheric disturbances such as those occurring during solar flare events will cuase sudden phase anomalies. Diurnal phase shifts and other anomalies are not a serious problem provided the user is aware of them. Resolution of part in 10^{10} requires less than a day using lf frequency transfer techniques.

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Frequency

Frequency tolerances are normally expressed in some part in 10ths. The following example shows the relationship between parts in 10ths and cycles per second.

Total μsec per day = $\frac{1{,}000{,}000\ \mu\text{sec}}{\text{SEC}}$

$\frac{60\ \text{sec}}{\text{MIN}} \quad \frac{60\ \text{min}}{\text{HR}} \quad \frac{24\ \text{hrs}}{\text{DAY}}$

$=86{,}400{,}000{,}000$ μsec per day
OR $86{,}000 \times 10^{6}$ μsec per day
OR $8{,}640 \times 10^{7}$ μsec per day
R 864×10^{8} μsec per day
OR 86.4×10^{9} μsec per day
OR 8.64×10^{10} μsec per day

In frequency comparison the following term is used.

8.64 μsec = 1 PART IN 10^{10} per day
17.28 μsec = 2 PARTS IN 10^{10} per day
86.4 μsec = 1 PART in 10^{10} per day

As an example consider a 1 MHz oscillator which has drifted 6 parts in 10^{10} during a 24 hour period. This represents a total of 51.84 μsec. Average frequency of the oscillator during the measurement period is:

Fav = Fnom 1 + △F/F Where Fav = average frequency

Fnom = nominal oscillator frequency

△F/F = average frequency error parts in 10ths

Fav = 10^6 (1 + $6/10^{10}$)
= 1,000,000.006 Hz
Indeed a small error.

Chart Recorder

The If Phase Comparator plots the phase difference of a local frequency standard vs. that of the received carrier by means of the Rustrak strip chart recorder. Full scale chart width is 16 2/3 μsec phase difference. If radio propagation phenomena were perfectly stable, (no noise or other error causing factors) and the local standard is in exact agreement with WWVB at 60 kHz, the chart trace resembles a continuous straight line. If the standards are not operating on exactly the same frequency scale, then the phase of one relative to the other will change with time, thus the chart trace will be a saw-tooth wave shape if the drift is more than 16 2/3 usec.

Referring to Fig. 1 a typical chart recording, the steep phase shifts at 5 AM and 8 PM are associated with differences in daytime and nighttime propagation characteristics. Also, greater phase noise is observed at night due to spheric activity. These factors make it advisable to perform calibration on the basis of daytime data taken either during one day, or taken at the same time on several consecutive days. In the following example, we are using data taken at 11 AM to 5 PM, for six consecutive hours. At 11 AM the chart read 5 μsec and at 5 PM 13.5 μsec. Total drift of the standard is 13.5 − 5 = 8.5 μsec. To use this data enter the charts of Fig. 2 vertically from the bottom (microseconds) to where the line intersects with the slanting 6 hours line. Then project horizontally to the left from the intersection and read fractional frequency error. In this

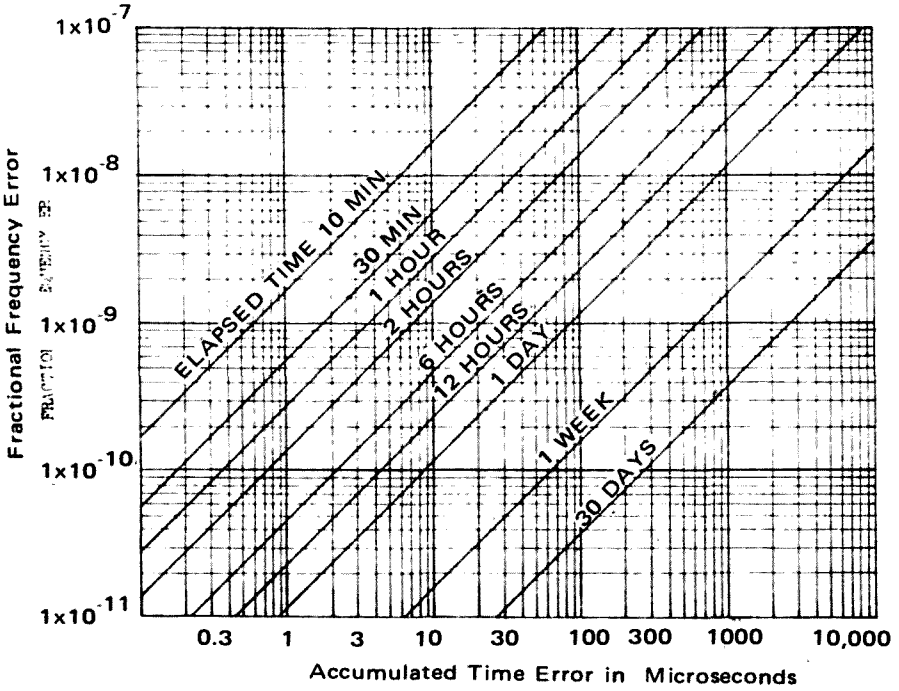


Fig. 2. Accumulated time error vs. fractional frequency error.

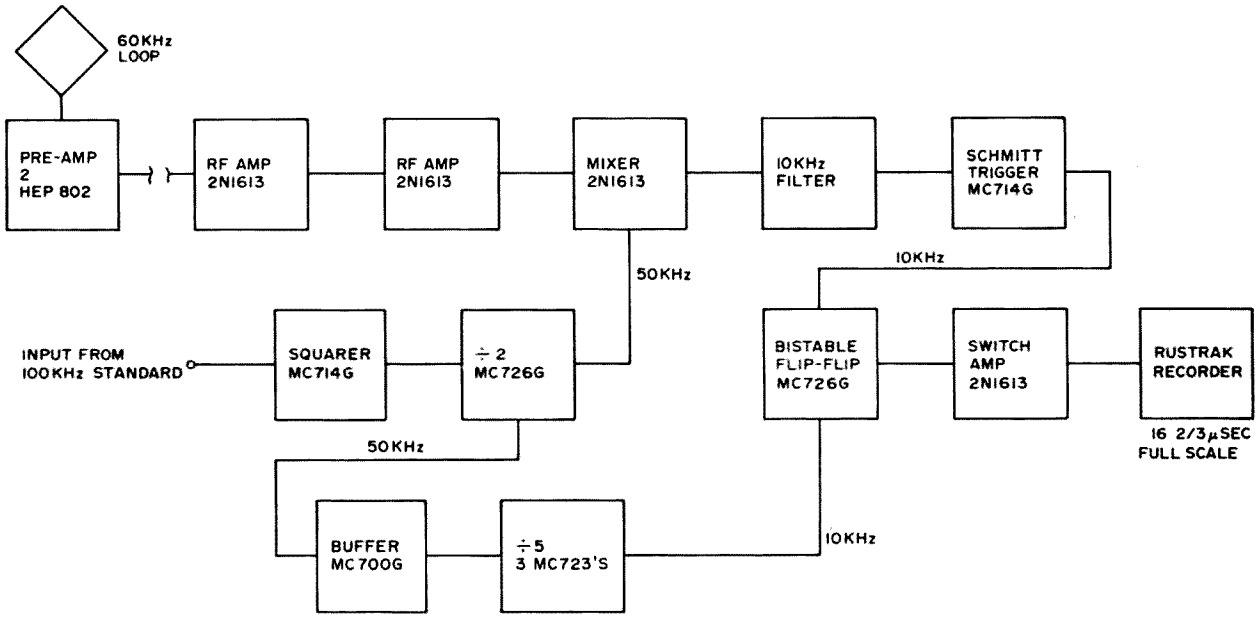


Fig. 3. Block diagram.

case the oscillator drifted 4 parts in 10^{10}

Gaps in the trace are caused by once-an-hour 45 degree phase shifts introduced into WWVB carrier for identification purposes. These gaps begin ten minutes after the hour and end fifteen minutes after the hour. If daylight fading should occur, it is a certain indication that ionosphere disturbances are taking place and are likely to be accompanied by apparent received phase instabilities.

WWVB Signal

Code information is also transmitted along with the continuous carrier. Time code information is presented by means of a level-shift carrier code. The time signals are indicated by 60 drops in the power level per minute, one marking each second and the amount of each drop is 10 dB. Also WWVB is off the air every other Tuesday during the daytime for maintenance.

Since this frequency comparator would operate best from a steady 60 kHz carrier, the 10 dB drop in carrier level does, unfortunately, affect the quality of the recorder trace when approaching either side of the chart.

Theory of Operation

Refer to the block diagram and the schematics for the following description (Fig. 3, 5 and 6).

The loop antenna is a balance unshielded type, wound with plastic covered wire on a wooded frame. Two square loops three and six feet on a side with 30 and 24 turns respectively were constructed and tried with satisfactory performances. The larger loop did furnish a greater signal level to the receiver.

The pre-amp is followed by two rf stages and a linear mixer. An rf gain control R2 is used to control the gain of the two rf stages. The background noise level at If is quite high due to atmospheric noise, lightning strokes and man-made noise. For this reason the system should include a noise suppressor and a very narrow bandwidth filter in order to maximize the signal-to-noise ratio. A pair of silicon diodes, connected back to back to the base of the linear mixer makes an effective noise suppressor and clipping level is controlled by the rf gain control.

A 10 kHz filter follows the mixer. The one shown using the cup cores has a bandwidth of 100 Hz. Several filter configurations were tried including a Q multiplier. Cores salvaged from 88 mhy coils used for RTTY gave a 200 Hz bandwidth. A more optimum bandwidth would be approximately one Hz.

The pre-amp, two rf stages and mixer are the only linear stages used in the receiver. The rest of the stages are either saturated or turned off. This is one panel control and two

trimmer controls located on the chassis.

Local oscillator injection to the mixer is derived from the 100 kHz frequency standard. A dual RTL IC gate converts the 100 kHz waveform to a fast-fall time square wave to act as a clock pulse for the divide-by-two RTL flip-flop. CR1 is to protect the IC from negative-going inputs. One of the two 50 kHz outputs from this flip-flop drives a 50 kHz tuned circuit to change the square wave to a sine wave for the mixer. The other output is fed into a divide by five circuit which generates a 10 kHz output.

The output from the 10 kHz filter drives a dual gate IC that functions like a low-hysterics Schmitt trigger whose threshold level is adjusted by R3. The Schmitt trigger drives one input of a MC726G flip-flop that is used as a Bistable flip-flop. The 10 kHz output from the divide-by-5 circuitry drives the other input to the Bistable flip-flop.

A Bistable flip-flop has two stable states and is forced from one state to the other by turn-off pulses received from WWVB or from the local frequency standard at a 10 kHz rate. When the two inputs are 180 degrees out of phase the integrated output current would be 50 percent duty cycle. As the phase changes between the two inputs, the average current would change and this is the purpose of the 2N1613 transistor and associated components to integrate the Bistable flip-flop output. A O1mA full scale, 1 inch per hour Rustrak recorder is used to display the integrated current.

Construction Hints

Only basic details and approximate dimensions will be covered since the diagrams and pictures are self-explanatory. The pre-amp is built on a 2 by 4-¾" one sided copper-clad printed circuit board and housed in a 5 by 2-¼" Bud CU-2104-A minibox. The receiver used a 4-½ by 9-½" printed circuit board. Scrub the foil side of the board with fine steel wool, soap and water. Rinse in clear water and dry. After the board is completely dry, spray the foil side with clear Krylon and the Krylon does not interfere with soldering. Nearly all components are mounted on the copper foil side of the board. Transistor sockets were used for the 2N1613 transistors but the leads on the IC's were bent and soldered directly. USECO type 1425 terminals were used to mount components onto and for tie points. Coils are mounted, using nylon screws and fiber washers. Approximate parts layouts is shown in Fig. 4.

Acquiring the required cores for the coils may be difficult because they are not across-the-counter or mail order items. The manufacturer usually has a $25 minimum order charge. Therefore, most builders will

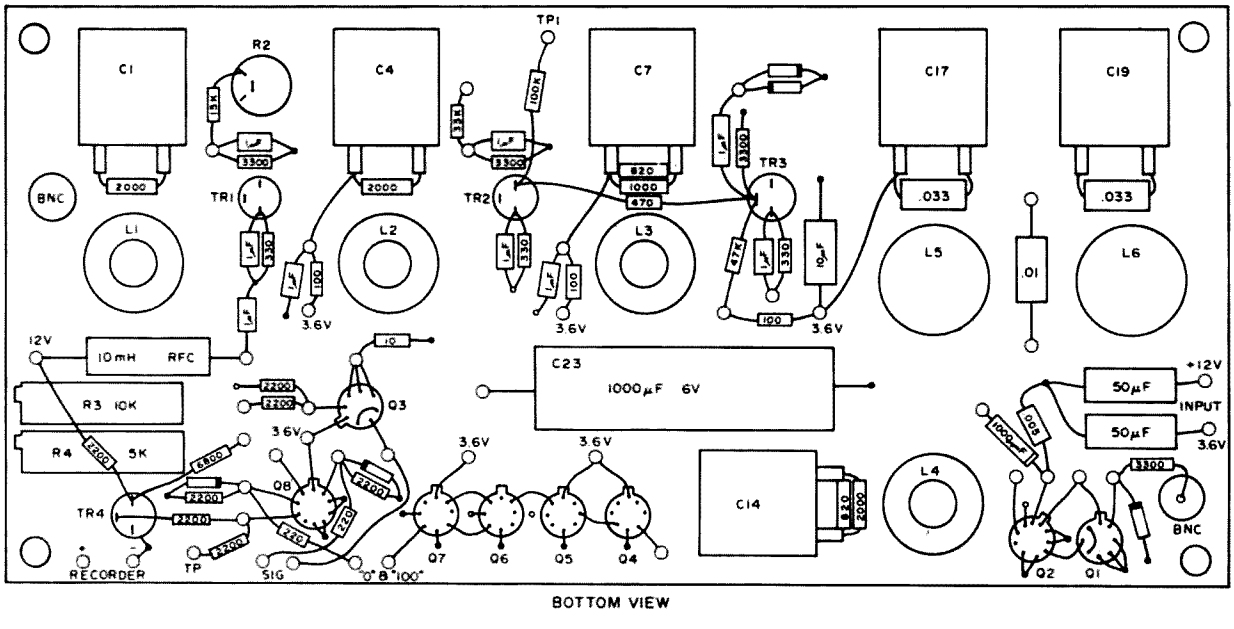


Fig. 4. Components lay-out.

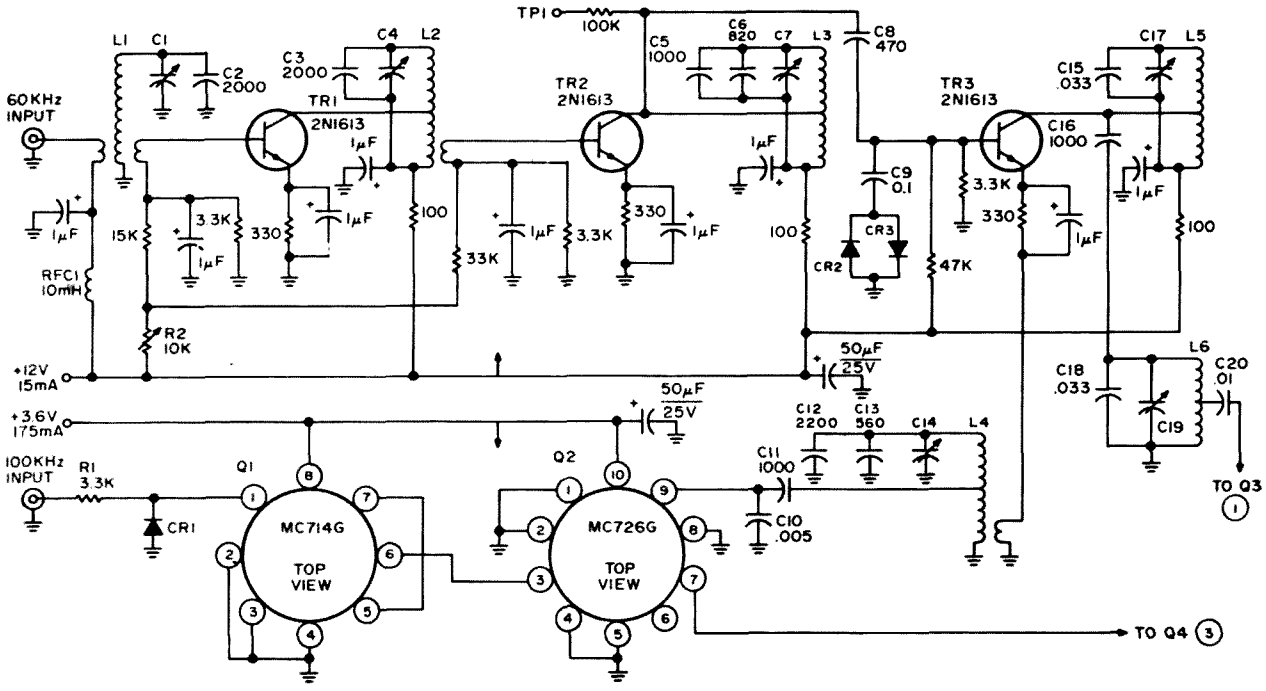


Fig. 5a.

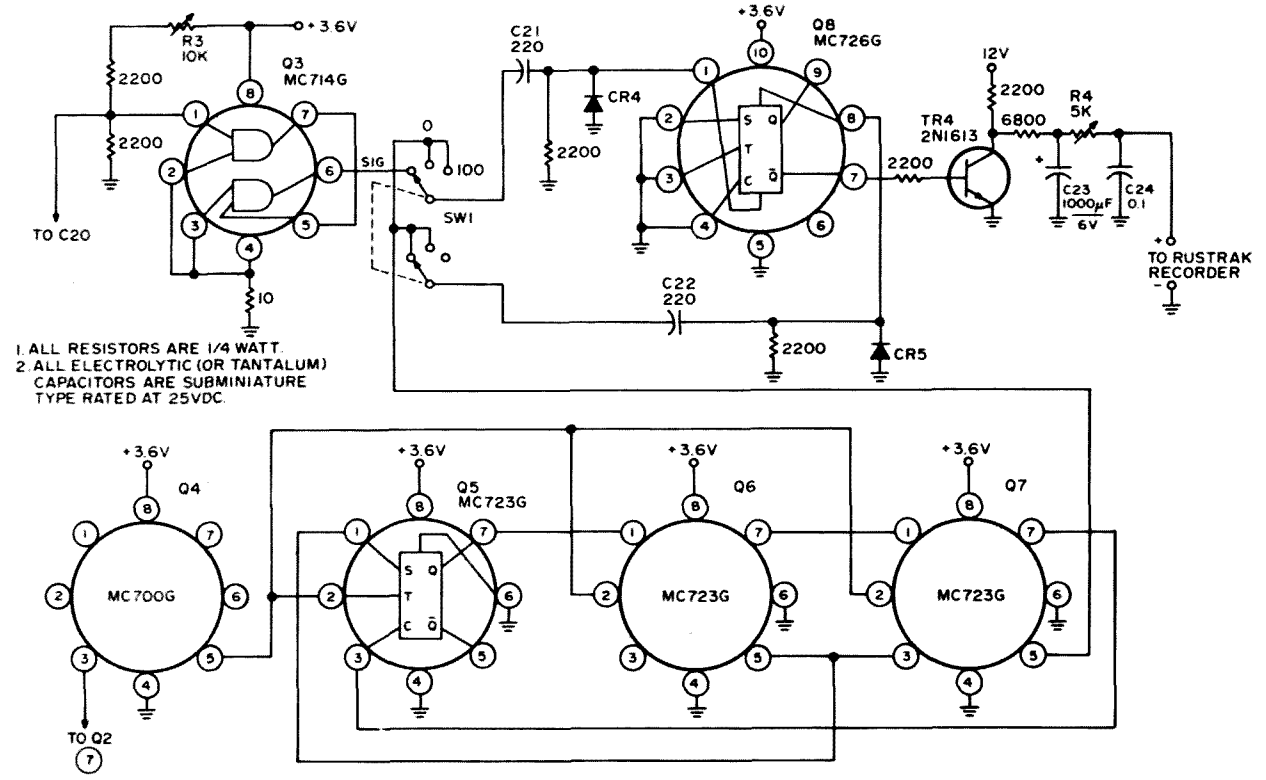


Fig. 5b.

Schematic.

have to do a little scrounging among friends or surplus stores to find suitable cores. The three 60 kHz coils on the receiver board have a Q of 70 and the pre-amp output coil has a Q of 200.

Other RTL IC's may be substituted for the ones specified, such as the Fairchild 914 or Motorola MC724P for the MC714G gates and Fairchild 923 or Motorola MC723P for the MC723G flip-flop.

Adjustment

A signal generator capable of tuning to 60 kHz and an oscilloscope is required. Connect the scope to TP1 and couple the generator to the loop antenna by wrapping a turn or two of test lead around one side of the loop. Peak the loop and the 4 60 kHz tuned circuits to 60 kHz. Move the scope to the mixer emitter and peak the 50 kHz tuned circuit. The 50 kHz signal should be adjusted for approximately 1VPP at the mixer emitter (this is assuming that a 100 kHz frequency standard is connected and the flip-flop is putting out a 50 kHz square wave). The input level of Q1 gate should not exceed 4VPP and may be adjusted by R1 to suit the 100 kHz frequency standard used by the builder.

The 10 Hz circuits can be peaked up by monitoring the Schmitt trigger input with a scope when a 60 kHz signal is fed into the receiver input. After this is accomplished connect the scope to the Schmitt trigger output and adjust R3 for a symmetrical wave form (be sure to keep the generator 60 kHz output level low). Check the output of the divide by circuit for a 10 kHz output. Switch Sw is used for calibrating the Rustrak recorder when the switch is placed in positions 0 and 100. The recorders full scale indication may be adjusted by R4 when the switch is placed in the 100 position. There is no adjustment for zero scale indication.

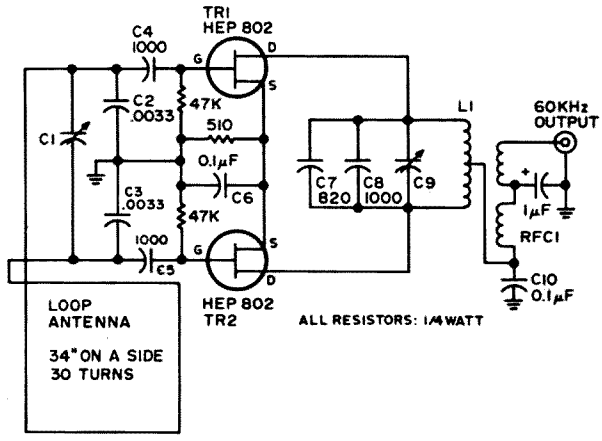


Fig. 6. Preamp. C, C9 – 275–970 μμF Elmenco padder 306; C2, C3 – 0.0033 μF Mylar (2200 μμF for 6 ft loop); C4, C5, C8 – 1000 μμF Dippled Silver mica; C6, C10 – 0.1 μF Centralab CK-104; C7 – 820 μμF Dipped Silver mica; L1 – 3 mhy C.T. Wound with No. 26 magnet wire approximately 85 turns on an Indiana General Corp. cup core TC7-04-400. Link is 3 turns of insulated wire; RFC1 – 10 mhy Ferrite core rf choke; TR1, TR2 – Motorola HEP 802 transistors or RCA 3N128.

PARTS LIST

C1, C4, C7, C14 – 115–550 μμF Padder Elmenco 304
C2, C3, C12 – 2000 μμF Dipped silver mica
CG, C11, C16 – 1000 μμF Dipped silver mica
C6, C13 – 820 μμF Dipped silver mica
C9, C24 – 0.1 μF Centralab Type CK Ceramic
C15, C18 – .033 μF 100 volt Mylar
C17, C19 – 1400–3055 μμF Padder Elmenco 315
C20 – .01 μF Centralab Type CK Ceramic
C21, C22 – 220 μμF Dipped silver mica
C23 – 1000 μF 6 volt Cornell-Dubilier Type BBR

R2 – 10K Ohmite AS ½ watt potentiometer
R3 – 10K Bourn E-Z Trim Type 3067-S 15 turn potentiometer
R4 – 5K Bourn E-Z Trim Type 3067-S 15 turn potentiometer

L1, L2, L3, L4 – 3 mhy Bifilar wound with No. 28 magnet wire approximately total 200 turns on Arnold Engineering Co. toroidal cores 206068-2. O.D. 0.8", I.D. 0.5", Permeability 125. All input and output links are 10 turns of insulated wire. Each coil is C.T.

L5, L6 – 7.5 mhy wound with No. 26 magnet wire approximately 140 turns on Indiana General Corp. cup cores TC7-04-400. Each coil is C.T.

SW1 – 2 poles 3 position rotary switch

CR1, CR4, CR5 – 1N155 Germanium diode
CR2, CR3 – 1N660 silicon diode

Q1, Q3 – MC714G Motorola RTL IC
Q2, Q8 – MC726G Motorola RTL IC
Q4 – MC700G Motorola RTL IC
Q5, Q5, Q6 – MC723G Motorola RTL IC

TR1, TR2, TR3, TR4 – 2N1613 Transistors

RFC1 – 10 mhy Ferrite core rf choke

Disconnect the generator and test lead from the loop antenna. Connect the scope to the mixer base and adjust the rf gain control R2 until clipping of the received 60 kHz signal occurs.

Experience has indicated that best results are obtained when a minimum number of manual corrections are made to the frequency standard to bring it within tolerance. It is desirable to over-compensate, rather than set the standard exactly on frequency. This results in the maximum time period between adjustment in order to maintain the standard within specific tolerances.

Local Frequency Standard

The frequency comparator requires 100 kHz from a local frequency standard with a minimum output of 4 VPP. Crystal calibrators similar to those used in communication receivers are not stable enough for use in this system (the same is true for most crystals mounted in snap action type ovens). A good frequency standard employ a crystal mounted in a proportional control type oven. Most crystals used in frequency standards are 1, 2.5 and 5 MHz with appropriate signal conditioners.

Performance

The performance of the frequency comparator described in this paper meets all of the design criteria requirements. The system phase shift caused by a 20 dB drop in input signal level is approximately 0.33 μsec. The rf gain control will introduce approximately 1.6 μsec phase shift over its full range but this is a fixed shift. With a stable frequency standard the system will phase track a part in the 10. There are limitations to this type of frequency comparator (compared to a complex phase-locking type), but never the less, this system will out perform any hf systems presently in use.

Two common questions have been asked whenever I have demonstrated the 60 kHz frequency comparator receiver and these are:

1. Would there be an error in the comparator measurements as the 100 kHz standard is being divided down to 50 and 10 kHz.

2. Where should the loop antenna be located?

Let's assume that a 100 kHz standard has drifted 10 Hz. A one Hz at 100 kHz is 10 usec long in time and 10 Hz at 100 kHz would be 100 usec. Dividing 100 kHz down to 50 kHz would also divide the drift by two but one Hz at 50 kHz is 20 μsec long and 5 Hz at 50 kHz would be 100 μsec. Thus by dividing a frequency it never changes the error but only the number of cycles.

Referring to the block diagram (Fig. 3), let us assume that the 100 kHz standard did drift 10 Hz high over a period of time. The output from the divide by two circuit will be 50 kHz plus 5 Hz. The 50 kHz plus 5 Hz does however mix with the received 60 kHz signal to produce a 9.995 kHz and this signal drives one input of the bistable flip-flop.

The 50 kHz plus 5 Hz is further divided by five to 10 Hz plus 1 Hz and this signal drives the other input of the bistable flip-flop. The bistable flip-flop counts a difference of 6 Hz between the two input signals. Since everything is in reference to the 60 kHz signal (one Hz at 60 kHz is 16-2/3 μsec) the 6 Hz in μsec would be 6 x 16-2/3 μsec = 100 μsec and this indicates that the 100 kHz standard did drift 100 usec.

As with any antenna the loop should be located clear of all structures, etc. To avoid regeneration, the loop should be at least 30 feet from the comparator receiver. The loop should be pointed edge wise toward Ft. Collins, Colo.

With the 3 foot loop located in the basement the comparator did phase track but the 60 kHz signal level was down. I compromised by installing the loop in the attic and this also solved the weather problem.

This project was for Area 5 MTS of the Air Force MARS program for updating methods of calibrating frequency standards. The writer would like to express his appreciation to Dick Bingham, W7WKR for his assistance in the write up, Bob Ellis, W7FNA/AF7FNA and Fred Reid Jr., W7EJD/AF7EJD for their assistance in the project.

...W7LHL

William F. Splichal, Jr. WA6QVQ
1160 Brace Avenue
San Jose, CA 95125

CIGAR TUBE GE Audio-RF Signal Generator

Miniature audio-rf signal generator (Fig. 1) for injecting signals into audio amplifiers or receivers can be constructed with a dozen components and contained in an aluminum cigar tube slightly larger than a pen. The circuit will operate with almost any pair of NPN or PNP transistors, whether silicon and/or germanium, by merely changing the battery polarity for the type transistors used. Surplus computer circuit boards or junked transistor radios can provide almost all the components necessary to construct this simple generator.

CIRCUIT

Circuit

The generator, Fig. 2, is basically an astable multivibrator which oscillates at approximately 1000 Hz. The sharp edges of the audio square wave signal are rich in harmonics up to approximately 200 MHz. and a single 1.5 volt penlight cell supplies the necessary power. Battery polarity for the various types of small signal PNP or NPN transistors is as listed in the table below:

Transistor Pair Type	Battery Polarity
A. 2 NPN silicon	As shown on diagram
B. 2 PNP silicon	Reversed
C. 2 NPN germanium	As shown on diagram
D. 2 PNP germanium	Reversed
E.1 NPN silicon and 1 NPN germanium	As shown on diagram
F.1 PNP silicon and 1 PNP germanium	Reversed



Fig. 1. Cigar tube audio-rf generator.

Construction

An aluminum cigar tube slightly larger in diameter than a penlight cell is used to house the generator. The generator as shown in Fig. 3 was fabricated on a small piece of Vector-Board and wrapped with electrical insulation tape. If more desirable

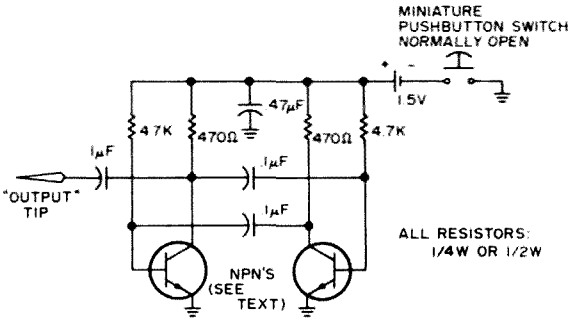


Fig. 2. Note All resistors—¼ or ½ watt.



Fig. 3 Component layout.

the generator may also be constructed on a small printed circuit board or soldered together in a string arrangement and wrapped with insulating tape. A feed-thru insulator with a small pointed tip is attached to one end of the tube to inject the output signal into circuits under test. A small male pin from a scrapped connector could be soldered onto the end of the feed-thru insulator to provide a longer extending output tip. Layout of the components inside the aluminum tube is not critical. A miniature push-button switch is located in the other end to apply power to the multivibrator.

Operation

The signal generator is operated by simply placing the pointed output tip of the generator on the electronics circuit to be tested and depressing the push-button switch on the other end. A wire lead may be connected between the case of the aluminum cigar tube and ground of the circuit to be tested. Grounding may also be accomplished by holding the signal generator with one hand and touching ground of the circuit being tested with the other hand. Signal injection into rf circuits may not necessitate the use of a grounding circuit from the generator to the rf circuit under test.

. . .WA6QVQ

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40 dB GAIN 2.5–3.0 N.F. @ 150 MHz

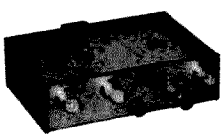


2 RF stages with transient protected dual-gate MOSFETS give this converter the high gain and low noise you need for receiving very weak signals. The mixer stage is aiso a dual-gate MOSFET as it greatly reduces spurious mixing products – some by as much as 100 dB over that obtained with bipolar mixers. A bipolar oscillator using 3rd or 5th overtone plug-in crystals is followed by a harmonic bandpass filter, and where necessary an additional amplifier is used to assure the correct amount of drive to the mixer. Available in your choice of input frequencies from 5–350 MHz and with any output you choose within this range. The usable bandwidth is approx. 3% of the input frequency with a maximum of 4 MHz. Wider bandwidths are available on special order. *Although any frequency combination is possible* (including converting up) best results are obtained if you choose an output frequency not more than 1/3 or less than 1/20 of the input frequency. Enclosed in a 4-3/8" x 3" x 1-1/4" aluminum case with BNC receptacles, power and antenna transfer switch. Thousands of our converters are now in use by satisfied customers, many of whom are government agencies and universities.

Model 407 price: 5–200 MHz $42.95
201–350 MHz $44.95

Prices include .005% crystal. Additional crystals $5.95 ea.

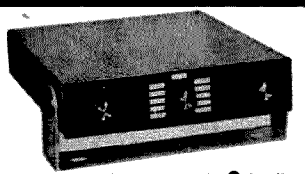
UHF 20 dB MIN. GAIN 3 to 5 dB MAX. N.F.



This model is similar in appearance to our Model 407 but uses 2 low noise J FETS in our specially designed RF stage which is tuned with high-Q miniature trimmers. The mixer is a special dual-gate MOSFET made by RCA to meet our requirements. The oscillator uses 5th overtone crystals to reduce spurious responses and make possible fewer multipliers in the oscillator chain which uses 1200 MHz bipolars for maximum efficiency. Available with your choice of input frequencies from 300–475 MHz and output frequencies from 14–220 MHz. Usable bandwidth is about 1% of the input frequency but can be easily retuned to cover more. This model is now in use in many sophisticated applications such as a component of a communications link for rocket launchings.

Model 408 price $51.95
.005% crystal included.

VHF FM RECEIVER
11 CHANNELS • 135–250 MHz



● 11 crystal-controlled channels. ● Available in your choice of frequencies from 135–250 MHz wide. ● I.F. bandwidth (channel selectivity) available in your choice of +/–7.5 kHz or +/–15 kHz. ● 8-pole quartz filter and a 4-pole ceramic filter gives more than 80 dB rejection at 2X channel bandwidth. ● Frequency trimmers for each crystal. ● 2 to 3 μvolt for 20 dB quieting. ● Dual-gate MOSFETS and integrated circuits. ● Self-contained speaker and external speaker jack. ● Mobile mount and tilt stand. ● Anodized alum. case, 6" x 7" x 1-3/8"

Model FMR-250-11 price: 135-180 MHz $109.95
181-250 MHz $119.95

Price includes one .001% crystal. Additional crystals $6.95 ea.

HOW TO ORDER:

All the preamps on this page are available only from Vanguard Labs. For receivers and converters, state model, input and output frequencies and bandwidth where applicable. Remit in full, including sales tax if you reside in New York State, direct to Vanguard Labs. Prices include postage by regular parcel post. For air mail or special delivery include extra amount; excess will be refunded. Send money order or certified check for faster shipment.

VANGUARD LABS 196–23 JAMAICA AVE. HOLLIS, N.Y. 11423

Parker C. Cope W2GOM
RD 1
Amsterdam NY 12012

the CW EXcavator

Digging signals out of the noise was a problem when Hertz made his experiments, and it's still a problem when we communicate with the astronauts. It's not just your QSO's that fade into the noise or get buried in the confusion. It only seems that way. One of the best tools for digging out a signal is a filter with a response that just matches the spectrum of the signal. The closer the match the better the digging. The CW excavator is an audio filter that really digs a signal out of the mud, and does it without ringing like a bell.

A filter that matches phone signals is nothing like a match for CW signals. A phone signal has a bandwidth of about 2.5 kHz to 2.8 kHz, while a CW signal has a bandwidth of less than 50 Hz. The actual bandwidth is directly proportional to dotting speed, and when the going gets tough most operators slow down so that the actual bandwidth required for communicating drops. Consequently, a receiver with a beautiful response for phone has a bandwidth more than fifty times wider than necessary for CW signals. When your QSO is the only one going, the extra bandwidth may not hurt much, but when the band is crowded it makes more than 50 more chances for interference. That is a lot of unnecessary QRM.

Ideally, only the signal within the filter's passband should be heard; all other off-frequency signals should be completely attenuated. A real world filter attenuates the off-frequency signals, but not completely. Fig. 1 shows how several typical filters perform. The dotted curve results from a single resonant circuit with a Q of ten tuned to 800 Hz. The 3 dB bandwidth is 80 Hz but the 40 dB bandwidth is 8000 Hz. If the Q were increased to 20, the 3 dB bandwidth would decrease to 40 Hz and the 40 dB bandwidth would decrease to 4 kHz off-frequency.

The dashed curve in Fig. 1 shows the result of cascading a similar resonant circuit with Q of 10 and also tuned to 800 Hz. The second cirsuit really helps. Increasing the Q of both circuits to 20 reduces the 3 dB bandwidth to 25 Hz and the 40 dB bandwidth to 400 Hz. This represents a big

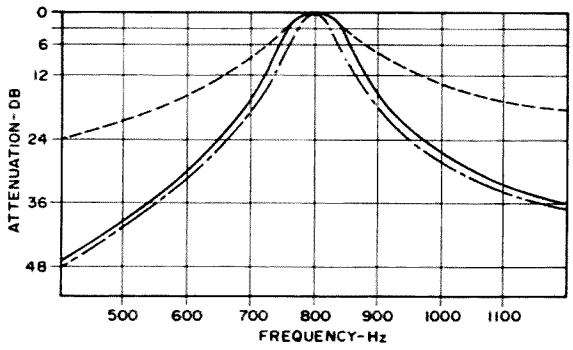


Fig. 1. Response of one and two tuned circuits.

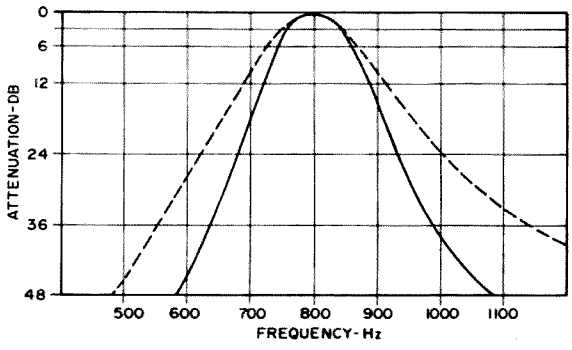


Fig. 2. Response of four stages.

improvement in cutting QRM but tuning and receiver stability become much more demanding and you may even notice a bell-like quality in the signal. Even a 50 Hz bandwidth makes receiver tuning touchy, and if your receiver is a little drifty, keep your transmissions short.

There is a way to have your cake and eat it too. Relatively high Q circuits tuned to slightly different frequencies increase the 3 dB bandwidth without giving up too much off-frequency attenuation. The solid curve in Fig. 1 results when two tuned circuits are stagger tuned; that is, one is tuned to a frequency above 800 Hz while the other is tuned below 800 Hz. The tuned frequencies are 772 Hz and 828 Hz and the Q's are 14. The 3 dB bandwidth, 80 Hz, is as wide as a single circuit with Q of 10 but the skirts are about as steep as two stages.

Since two tuned stages are better than one, and stagger tuned is better than synchronous tuned, we might conclude that the more stagger tuned circuits the better. They are – if they are on the right frequency and the Q's can be achieved. The CW Excavator uses four tuned stages arranged to form two staggered pairs. Fig. 2. compares the response of two staggered pairs, the solid curve, to four synchronously tuned stages; that is, four stages all tuned to the same frequency of 800 Hz. In both cases the 3 dB bandwidth is arranged to be 100 Hz.

To avoid the problems of tuning and loading coils and maintaining the proper impedances, the CW Excavator uses active filters. The active filter achieves the effects of L and C with R's and C's and an operational amplifier. Unlike the LC resonant circuit, the active filter is relatively immune to load changes, and it can provide gain as well. Although the CW Excavator has limited power output, it can easily drive a pair of high impedance phones.

The schematic of the CW Excavator, shown in Fig. 3, may not look like a filter so let's take it apart and see how it works. The componenets shown within area "B" make an active bandpass filter 85 Hz wide tuned to 756 Hz. The components within area "A" make an active bandpass filter 93 Hz wide tuned to 844 Hz. These two stages make a staggered pair with a bandwidth of 125 Hz centered at 800 Hz. Cascading two such pairs produces a filter with a 3 dB bandwidth of 100 Hz centered at 800 Hz. The theory behind the active filter is rather new and the derivation of the working equations is quite involved. Fortunately the qualitative description of an active filter is straightforward, even though the quantitative analysis is something else. Basically, the active filter is a feedback amplifier in which the magnitude and phase of the signal fed back determine the overall frequency response.

A brief discussion of the workings of a feedback amplifier will help in understanding the active filter. The block diagram, Fig. 4, shows a general amplifier. For the sake of discussion, the amplifier is assumed ideal: The input impedance is very high; that is, no significant signal current flows in the input. The gain of the amplifier is very large. The output of the amplifier is exactly out of phase with the input. The output impedance is very low; that is, the output voltage is independent of the load. Since the voltage gain is very large, a minute voltage, e, at the input causes a very large output voltage. Since there is no signal current flowing in the input of the amplifier and the voltage e is essentially zero, the current I m must be

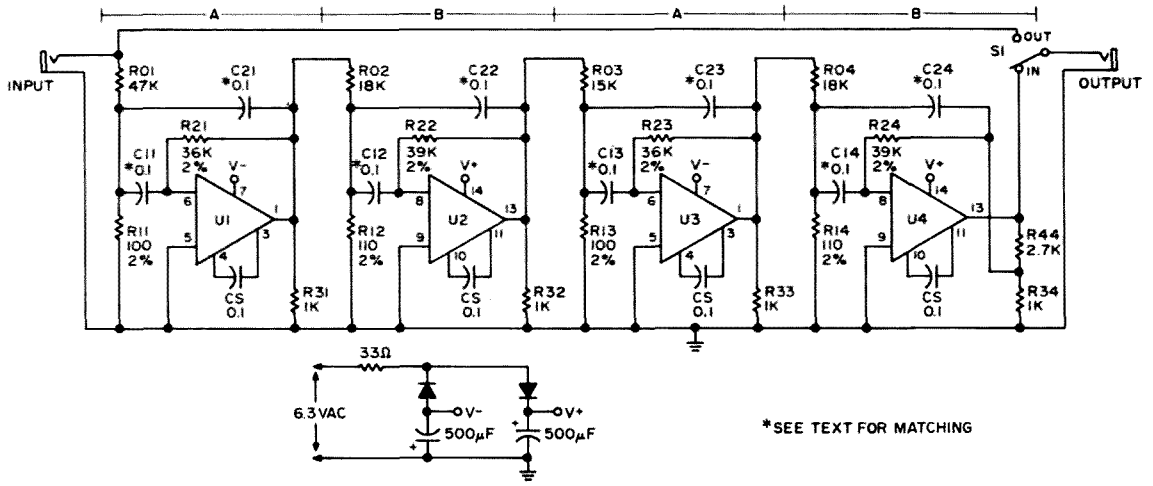


Fig. 3. CW Excavator.

equal and opposite to the current Ifb. Consequently, the voltage gain may be expressed as:

$$G = \frac{E_O}{E_S} = \frac{Z_{fb}}{Z_{in}}$$

If Zfb or Zin vary with frequency, the gain of the amplifier with feedback will vary with frequency. The IC operational amplifier fills the requirement of gain block so the secret of designing active filters reduces to designing feedback networks that vary with frequency in a prescribed way.

A qualitative description of the active bandpass filter shown in Fig. 3 area A is typical of all four stages. R11, R21, C11, and C21 make up the frequency sensitive feedback network around the operational amplifier U1. Cs and R31 stabilize the amplifier so that it can not oscillate under any feedback conditions. R01 and R11 form a voltage divider that sets the gain of the stage. The first stage is arranged to have a loss of 10 dB, the second and third stages have unity gain, and the fourth stage has a gain of 10 dB. Consequently, the overall gain is about one. R34 and R44 increase the gain and maximum output level of the amplifier while maintaining an acceptable feedback level.

At very low frequencies the reactance of C11 is large compared to R21 and the voltage gain is low. At very high frequencies the reactance of C21 is low compared to R11 and the gain is again low. At some in-between frequency the reactance of C21 is large compared to R11 and the reactance of C11 is small compared to R21. Consequently, the voltage gain is high at this in-between frequency. Specifically, the frequency of maximum gain or center frequency of the passband is:

$$f_{01} = 1/2\pi\sqrt{R_{11}R_{21}C_{11}C_{21}}$$

The maximum gain, relative to the voltage across R11, is:

$$G_{11} = R_{21}C_{21}/R_{11}(C_{11} + C_{21})$$

The 3 dB bandwidth is:

$$B_1 = 1/2\pi R_{11}(C_{11} + C_{21})$$

In designing an active bandpass filter, any absolute values of R or C can be used that satisfy the above equations. If you need a special audio filter for your RTTY or repeater control experiments, these equations should put you on your way. Since odd values of resistors are more readily available than odd values of capacitors, pick a standard capacitor value and go from there. The calculations may be laborious but they are straightforward. These are the steps in calculating the values of any particular filter.

1. Calculate the product R1 and R2 from the chosen values of C1 and C2 and the desired frequency.

$$R_1R_2 = 1/(2\pi f_0)^2C_1C_2$$

2. Calculate the value of R1 from the desired bandwidth and the chosen values of C1 and C2.

$$R_1 = 1/2\pi B_1(C_1 + C_2)$$

3. Calculate the value R2 from the R1R2 product obtained in step 1 and the value of R1 obtained in Step 2.

$$R_2 = R_1R_{2/R_1}$$

4. Calculate the gain from the values of R1, R2, C1, and C2.

$$G_1 = R_2C_{2/R_1(C_1 + C_2)}$$

5. Calculate the value of R0 from the desired gain, G0, and the value for G1, and R1 obtained in Steps 2 and 4.

$$R_0 = R_1(G_1 - G_0)/G_0$$

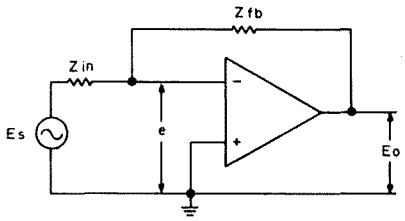


Fig. 4. General feedback amplifier.

If you are designing a new filter remember that the calculated value for R1 results from paralleling the physical R with R0 in series with the input's source resistance.

The effects of component variation and tolerance on the individual stage, and consequently, on the overall filter performance, are rather critical. Center frequency, bandwidth, and gain all vary with R1, R2, C1 and C2. Gain variation is not particularly important since it doesn't effect the filter's performance in digging signals out of the bedlam. On the other hand, only small variations in center frequency can be tolerated. In general, increasing the frequency separation of the stages making up the staggered pair increases the overall bandwidth and produces a double peaked response. Decreasing the bandwidth of the individual stages also produces a double peaked response. Reducing the frequency separation of the stages reduces the overall bandwidth and produces a single peaked response. Increasing the bandwidth of the individual stages increases the overall bandwidth and also produces a single peaked response. The stage bandwidth variation caused by gross component tolerances barely effects the overall response. For example, reducing the stage

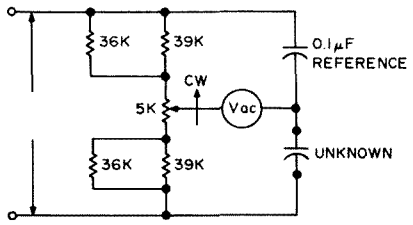


Fig. 5. Comparison bridge.

bandwidth to half only causes 2 dB peaks and a bandwidth change of about 7%. The center frequencies of the individual stages in the staggered pair and are very critical and normal component tolerances result in drastic performance changes. For example, if either R1, R2, CI or C2 were 10% low, the center frequency would be 10% high. If this were the high frequency stage, the peak would shift from 844 Hz to 928 Hz. If one of the components in the low frequency stage were 10% high, the center frequency would shift from 756 Hz to 670 Hz. The bandwidth of the pair would consequently be about 250 Hz. Obviously, steps must be taken to make sure the stages are tuned to the proper frequencies.

One way to put the stages on-frequency makes R2 variable, but that requires an audio generator that can very accurately set to frequency. Using close tolerance parts avoids the problem but the availability and cost may rule out that solution. A compromise uses semi-precision resistors with 2% tolerances and ordinary mylar capacitors with 10% tolerances. The capacitors used in a particular stage are paired so that their product is near 0.01×10^{-12} to put the stage on-frequency. As a consequence of this pairing, the sum is also very near the desired 0.2 μF required to produce the proper bandwidth. The secret is to pair a high plus tolerance with a high minus tolerance and a low plus tolerance with a low minus tolerance.

If you have access to a good capacitance bridge and a stock of 0.1's you've got it made. Even if you don't have a big stock of capacitors and don't have a bridge, there is a way out. With twelve 0.1 μF's required for the complete filter, the laws of probability favor your finding four good pairs. The problem is to find which capacitors are relatively high and which are relatively low so they can be paired. The technique I used

doesn't take special equipment, just time and patience. A 5K pot, and an ac voltmeter plus the parts needed for the filter can be used to make a comparison bridge.

The relative capacity of the 0.1 μF's can be determined by temporarily using the semi-precision resistors as part of a bridge as shown in Fig. 5. The meter used to detect the null can be either a VTVM or a 5000 Ω per volt meter with a 3V range. The pot should have a linear taper just to make life easier, and a dial or pointer on the shaft helps in judging the relative position of the pot's arm. Arbitrarily pick any one of the 0.1μF's to use as the reference in the bridge.

The procedure for determining the relative capacities is as follows: Connect the capacitor to be evaluated into the "unknown" position in the bridge and adjust the pot for a null on the meter. The farther CCW the arm is from mid-position the samller the unknown capacitor is relative to the reference capacitor. Measure each of the capacitors and identify them according to their relative capacity. To determine the location of the reference capacitor in the overall order, replace it with the smallest measured capacitor and repeat the measurement.

Matching the capacitors is essential to making a filter with predictable characteristics. If the dial on the pot doesn't provide much resolution, use the following method to recheck the capacitors. Check the capacitors in increasing order of capacitance and note that the pot must be turned a little more CW to null each capacitor. If the pot must be turned CCW to null, the capacitor being measured is smaller than the one previously measured. After the capacitors are arranged in order of capacitance, they can be paired.

The two largest and two smallest capacitors are used as the stabilizing capacitors, Cs (Fig. 3). Only the middle eight capacitors are used in the frequency sensitive feedback networks. Of these eight capacitors, pair the largest with the smallest, the next largest with the next smallest and so on. Use any pair in any stage of the filter; that is, $C_{1\_}$ and $C_{2\_}$ must be a pair.

Power for the unit is not critical; the supply shown as part of Fig. 3 need not be used if you have other sources. Any supply voltages between ±5 volts and ±15 volts can be used, and they need not be balanced. The current drain is only 8 mA with 6 volt supplies and about 20 mA with 15 volt supplies. Ripple on the supplies can be pretty high without adverse effect; the supply shown in Fig. 3 has about 0.25 volts ripple and there is no detectable hum in the output.

Any construction technique can be used, the layout is not critical. In fact, the leads to the filter bypass switch S1, need not be shielded. I put my filter on a 2" x 5" piece of Vectorboard in a min-box. I used μA739's because that's what I had, but the 709 should work as well. If you want to use 709's, remember to stabilize the amplifier for unity gain; for the 709A that would be 5000 pF in series with 1.5K between pins 1 and 8, and 200 pF between pins 5 and 6.

There is no trick to using the filter but its extreme skirt selectivity can produce some puzzling effects until you think about it awhile. For example, with the filter "in," you can't tell when the receiver or filter are overloaded. The great selectivity rejects the distortion products, so there is no change in the sound of the audio, even under severe overload. The only solution I've found is to reduce the receiver's gain until the output is obviously less than maximum. With my 2000Ω phones the maximum output is uncomfortably loud, so I know that a comfortable level is below overload.

The effects on a phone signal may cause some head scratching too. The gain of the filter is about unity for 800 Hz, so there is little change in the level of an 800 Hz note when the filter is switched "in" or "out," but a comfortable level signal with filter "out" The reason: the energy in the 750 Hz to 850 Hz segment of the phone signal is very small compared to the total energy. This is probably the most dramatic demonstration of the CW Excavator's ability to reject off-frequency signals and cut the QRM.

If you want to dig CW, the CW Excavator is the tool. It will improve a good receiver and give an ordinary AM or SSB receiver CW selectivity that is as good as any. If the QRM discourages you, build the CW Excavator and be prepared for a change.

...W2GOM

Bill Hoisington K1CLL
Far Over Farm
Peterborough NH 02358

ANTENNAS and TEST RECEIVERS for 1296, 2300 and 3500 mHz

Using the oscillators described in 73[1] along with the diode receivers described here, it is possible to set up a working UHF amateur station for the 1296, 2300 and 3500 MHz amateur bands. The oscillators first will help you tune the antenna and receiver, then will work as a transmitter and as a local oscillator for superhet receiver operation.

The 1296 Diode Receiver

At this frequency you should begin to take care or you won't finish up with a good tunable receiver. The following notes and precautions should help you to line up a workable unit for the band.

1. Looking at Figs. 1A, B, C and D, the nylon bolts used for tuning and adjusting screws must be held firmly by a bakelite or other insulating strap that uses two bolts, as in detail in Fig. 1C.

2. The spacing of L1 to the baseboard should be small.

3. C1 should be made up with care, as in detail shown in Fig. 1C, keeping in mind that the inductance of the movable tab part of C1 should be as low as possible. You could use penny tuning between the baseboard and L1 but that gets more involved mechanically.

4. The adjustable input coupling capacitor C2 should be made up as in Fig. 1D, which shows one continuous piece of spring copper strap from J1 over to the movable part on top of L1.

5. Again, the diode must be a good one. I haven't had much luck with UHF diodes such as 1N82's and the like. The TV and radio people furnish some dandy low-cost

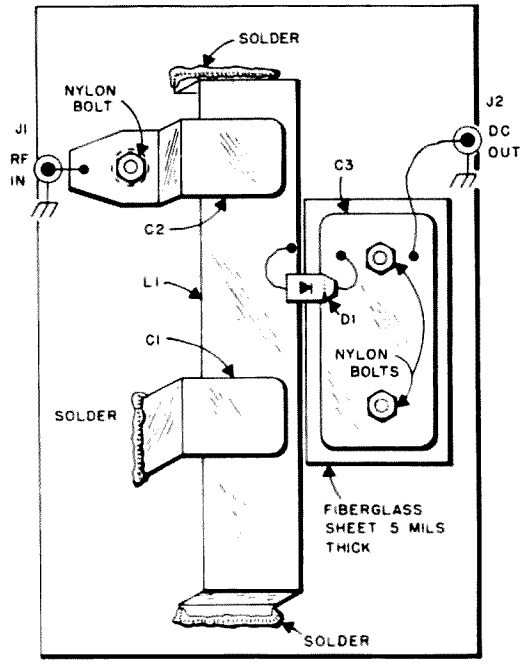


Fig. 1A. Top view of the 1296 MHz diode receiver. L1=2 1/4" long, to first bends (top); 9/16" wide brass strip; C1 = spring copper strap, 1/2" wide, top part 3/4" long, vertical section 1/4" long; C2= spring copper strap, 3/8" wide, part above L1 1/2" wide; C3= brass plate, 1" x 1/2".

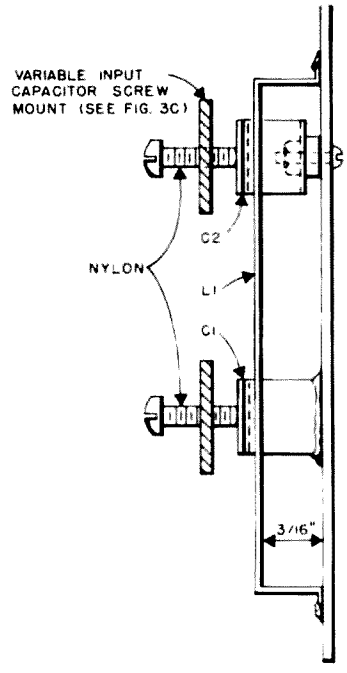


Fig. 1B. Side view of the 1296 MHz diode receiver.

items for us amateurs, but if they make a diode good for channel 83, that's as far as it will go. It may just meet a spec (one of which I've seen called for a noise figure of 14 dB for 890 MHz) and be practically worthless for 1296 MHz amateur use. Use a good X band diode, and you won't have that item to worry about.

That about does it for this little 1296 MHz plank. The size suits a minibox and it will start you off on 1296, checking power out of oscillators, antenna tuneup, frequency measurements, antenna gain by the distance method, etc.

The 1296 MHz Standard Test Antenna

A little scaling down, dividing by three, and a snip here and there with a dentist's tin snips, and I soon had two antennas ready for test.

Using the oscillator previously described, and the 1296 MHz diode receiver with the half wave line just detailed, the test system of Fig. 2 was set up. The meter began to move and the antenna tuning was started in the same manner as in the 432 MHz procedure. However, things don't always work that easily. There didn't seem to be any great amount of "soup" around the room. The new receiver was checked against a

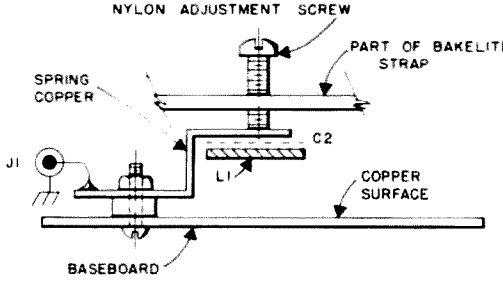


Fig. 1C. End view of the 1296 MHz receiver and C1 detail.

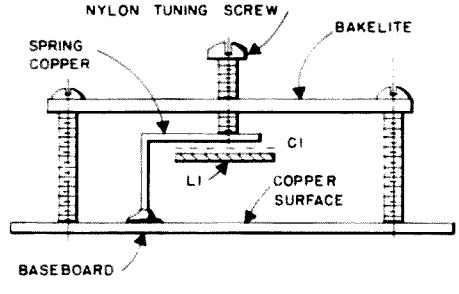


Fig. 1D. Side view of the 1296 receiver, and detail of C2.

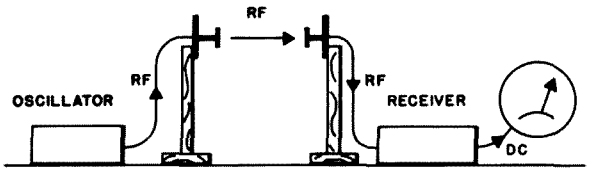


Fig. 2. Test setup.

couple of others using cavities, and straplines in rectangular boxes, and was found to be their equal for dc output for a given amount of rf. It was just this rf that didn't want to "give." All kinds of chokes in the emitter and other arrangements were tried in the 1296 MHz test oscillator to bring up more power, but to no avail. I finally had to resort to taking out the Motorola HEP56 transistor and putting in a KMC H104. The HEP56 shows good power on 432, lights a bulb and all, but on 1296 MHz it just doesn't seem to cut the mustard. After all, it's only $1.50 and it wasn't made for 1296 MHz use.

The KMC H104 does the job though, and there is one other item I found while working on the oscillator to bring it up to maximum power. I have referred several times to a sliding short under the collector strapline L1, for rough tuning. It does that all right but for maximum Q, starting oscillation every time, and trying for maximum output into small test antennas it appears to be better to cut L1 to the desired length and solder it down tight to the baseboard. The high rf currents and extreme low impedance at the ends of the half wave line L1 demand good soldered and wide-strap joints in order to have the highest Q.

Tuning can then be done by changing L1's spacing from the baseboard, with higher frequencies resulting from closer spacing. Further tuning can be achieved by using the grounded tab type of tuning capacitor shown as C1 in the following Figures, and used on the 1296 MHz receiver described.

Getting back to the antenna tests, now that good oscillator power was achieved, Fig. 3A shows the top view and Fig. 3B the front view of this convenient piece of test equipment for the band. It is of the same general type as the 432 MHz antenna described earlier but you will have to pay more attention to details, such as keeping the

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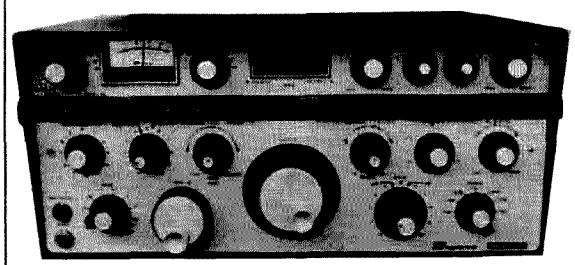
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reflector sheet rigid, adjusting C2 correctly, and finding the best value for D, the spacing between radiator and reflector.

C1 is made by tapping the copper-clad reflector sheet and installing a shiny new brass 6/32 bolt two inches long, which you can get in most household hardware stores now by paying about 10¢ a piece, putting a locking nut on it, and soldering the nut to the reflector copper sheet after adjusting for the desired locking tension. On the end of the bolt facing the radiator solder a brass nut and file it flat. This makes up C1 which is tuning good now, and is spaced about 1/8th in. from the radiator, using the dimensions of Figs. 3A and 3B.

Any flexibility in the reflector sheet makes it difficult to tune up with C1, which is of course sensitive to any changes in its spacing. Use thicker copper-clad, a wood backing, or a nylon bolt between the radiator and the reflector to hold it in an exact and steady position.

That should get you started on the air, at least across the room. It's not as easy as all

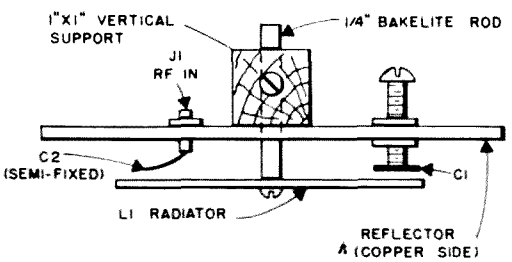


Fig. 3A. Top view of the 1296 MHz test antenna. Spacing, L1 to reflector – 3/8"; C2 to center of radiator – 3/4"; length of L1 – 3 5/8".

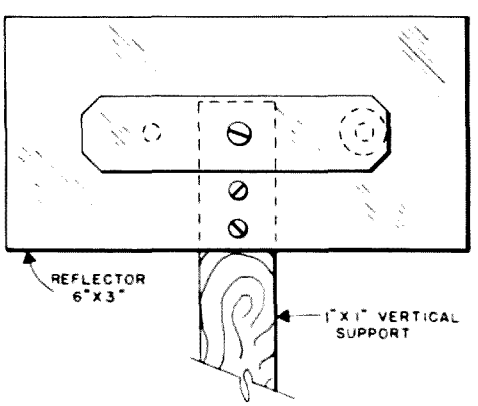


Fig. 3B. 1296 MHz test antenna, front view.

that every time, though. You can light off the oscillator, it shows power, with the H104 transistor collector meter dipping on 1296 oscillations like the good old tubes used to do on five meters, hook up one antenna to the oscillator, the other to the receiver, face them up across the bench, throw the "On" switch, and the receiver output meter may not even budge.

This has happened several times here, so don't worry. Providing you have built the four items mentioned as described here, it just means that one or more of them are not on frequency. Remember, that's four items to be on frequency. The same frequency. Recheck the receiver and transmitter frequencies with a cable and loose coupling, put the antennas close together, almost touching, and the receiver should take off. As mentioned above, don't worry, it will eventually. It's one of the laws of nature! One part of that law just happens to require that all those four items must be on the same frequency, or close. How close, you'll soon find out.

This 1296 MHz band is a real transition for antennas. The two-element job herein can start you off on tests. Then you can reduce the size of the reflector and point the assembly into a skeletonized parabolic dish (see Lafayette Radio, $16 for a five footer, $26.50 for a seven footer – I'm only reading out of their catalog). You may have to cover the reflector rods with copper or aluminum screen though, because, once again, those TV lads have it tuned up for 890 MHz only, channel 83. After that, the higher frequencies may start to leak through those too widely spaced rods.

You can also rig up nice compact phased arrays, and such.

Receiver 2300 MHz

This little gem is quite similar to the 1296 job, with everything a little smaller. Figure 4 shows the layout. While L1 shows as only 35 millimeters, or 1 3/8 in. long, don't forget that the bent down or vertical portions of L1 counts also, making L1 35 plus another 12 millimeters, for a total length of 47 millimeters. This works out to be near 7/10ths of the half wavelength, which is

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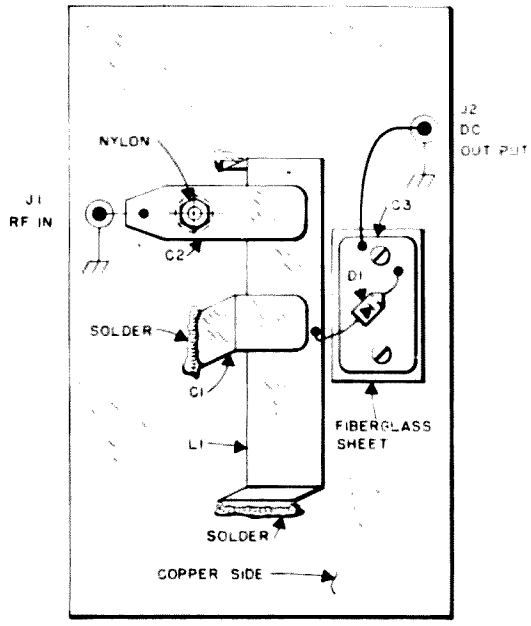


Fig. 4. Diode receiver for 2300 MHz. L1 = 1 3/8" long on top, spaced 4 mm (5/32") from baseboard; C1 and C2 adjusted by nylon bolts as in the 1296 MHz receiver.

reasonable enough considering the parallel capacitor C1, and the shunt diode D1. For the rest, pay attention to the items as listed for the 1296 job and you should be in tune with the 2300 MHz oscillator.

This is the band where parabolic dishes really begin to show power gains. Just a hint – we tested an old 23 in. aluminum dish which has been carried in our 45 ft junkbox since the good old Canal St., NY, surplus days of the late '40s, and found a gain of around 144 times a dipole. See what I mean?

Just in case I didn't mention it lately, I use a 50 microamp meter on the receiver dc output, again, Lafayette Radio, $4.75, with a switch for times one, times 10, and times 100. You can also set it up to read .5 and 5V if you like. Beyond that voltage, better watch those $3 diodes! Or just move the antennas further apart. Or cut down on the oscillator power with that emitter pot I keep talking about.

This frequency is part of the S band of microwave radar and I consider it to be past the transition stage and well into the field of parabolic reflectors, although my favorite antennas, the lenses, don't show up in a startling fashion till we reach the X band (You know by now, just keep reading!)

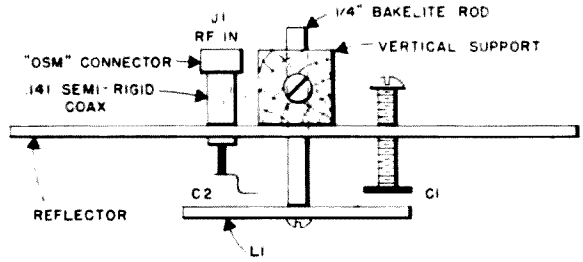


Fig. 5. Test antenna for 2300 MHz. L1 is copper strap, 1 13/16" long by 3/8" wide; reflector is 6" by 3"; spacing of L1 to reflector is 5/16"; distance from C2 to center is about 3/8" (should be maximized on test).

Test Antenna 2300 MHz

Just for fun, as I look at the 1296 and the 2300 MHz antennas on their little walnut test stands (I happen to live near an instrument case manufacturer) in front of me, the ratio of the lengths of their radiators was checked against the ratios of their frequencies, to see how the scaling down was progressing.

The 1296 MHz radiator L1 is 91 millimeters long, and the 2300 one is 46, which is almost exactly double. But twice 1296 is 2592, so there is probably a shortening factor working there somewhere. Let's check the 3500 MHz antenna, to jump ahead a little. It is 32 millimeters long. Three times 32 is 96 millimeters, close to 1/3rd of the 1296 MHz antenna length, and three times 1296 is 3888 MHz. Works out fairly close. With C1 operating in shunt, you probably could scale them exactly, although there are other factors, like the width of L1, end effects, etc. Just interested, so assume you might be also.

Figure 5 shows the details of the 2300 MHz test antenna. I used .141 in. OD semi-rigid coax for the cable input, and chickened out with an OSM connector instead of a phono jack. After all, this is microwave frequency! I'm still working on the idea of a low-cost connector for you (and me too).

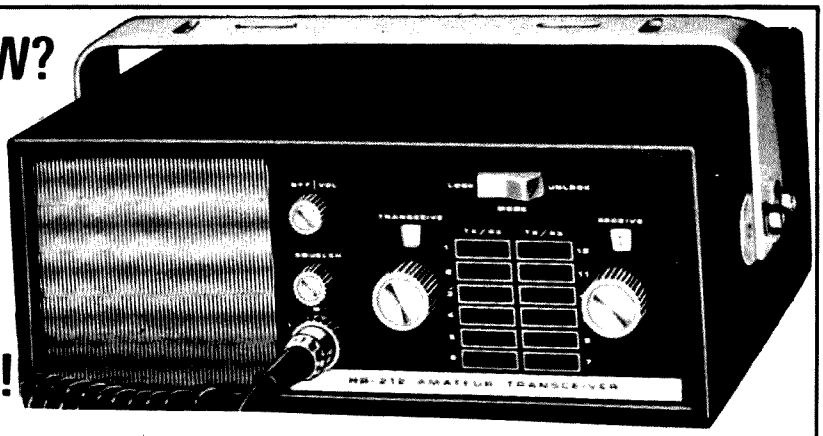
To use this antenna as a feed to work into a parabolic dish for high gain, cut down the size of the reflector sheet, as your energy coming out of the dish has to go out forward past the primary feed. See Fig. 6 for diagram of element placement.

With gains of well over 20 dB for a 23 in. dish, you can begin to see some reasons for

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this band. Think about radar on your present license, DX from mountain tops with the battery supply for these rigs, etc.

3500 MHZ Receiver

Here I chickened out again. Not for long though. It's just that here is another transition region, this time between open-air strapline and enclosed coaxial cavities.

It's a real project to make a comparison between the two methods and that will be another story.

So, for the time being, I used the diode-equipped coaxial wavemeter, as a receiver for this frequency. It works very well of course, but the coaxial tuner part is a little difficult for the homebrewer to make. I hope to have some of these made up, but this may take a while. Maybe you'd want to jump all the way to X band anyway?

Figures 7A and 7B show the layout of the top side, and some inner details for reference. This piece of equipment can be very useful. It measures frequency from 1 to 12 GHz, and makes a nice mixer for those frequencies also. And a diode test receiver for uses such as the present one being described.

What more can I say about it? There is a tremendous world of microwaves for amateurs ahead of us. We have the bands, at least today, and now with $5 transistors we can make battery portables to use them. Let's go!

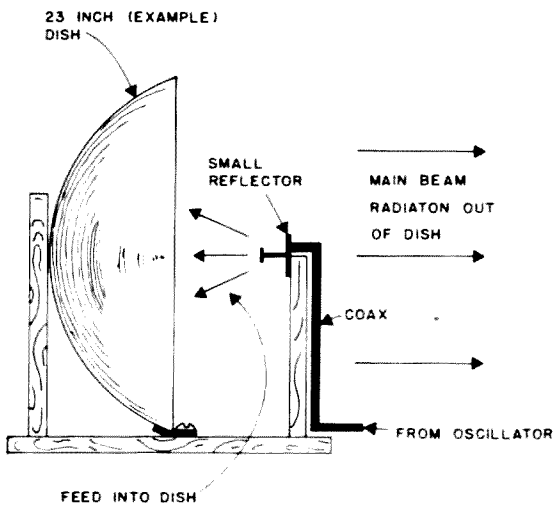
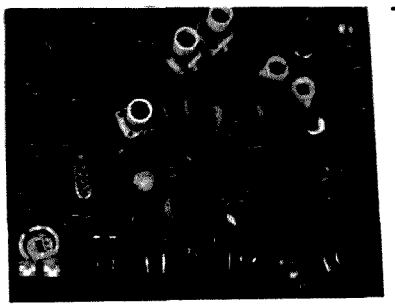


Fig. 6. Element placement, parabolic antenna, for 2300 MHz.

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3500 MHz Test Antenna

As mentioned earlier, oscillator for the 3500 MHz amateur band, you may not need this band for a few years, but it is interesting to see how it works, so a test antenna was built and tested.

About two millimeters was trimmed off one end during tuneup and it is now operating with plenty of "sock" using the oscillator mentioned above.

Figure 8 shows details with everything about the same as at 2300 MHz except that it was about half the size, and I dropped down to a 2/56 size bolt for the tuning capacitor C1, and had to cut off a portion of the one-by-one red cedar vertical mounting stand to install J1.

This little firecracker pût out a lot of power into the room, but some of that may be due to the $200 Fairchild transistor! ($50 in *steady*, 1000 lot purchases)

Just a little touch of trouble while tuning up the 3500 mHz antenna. Not with the antenna, though. The oscillator has an OSM connector on it, and I wasn't getting any rf

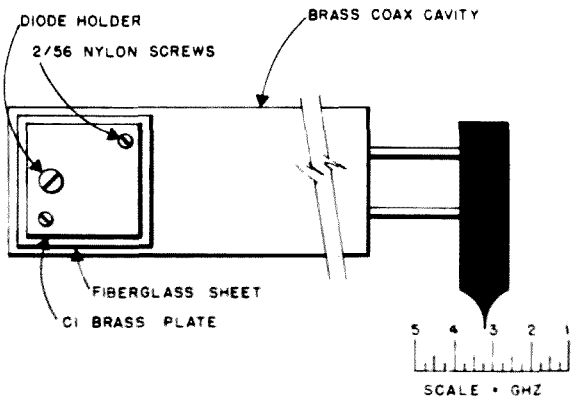
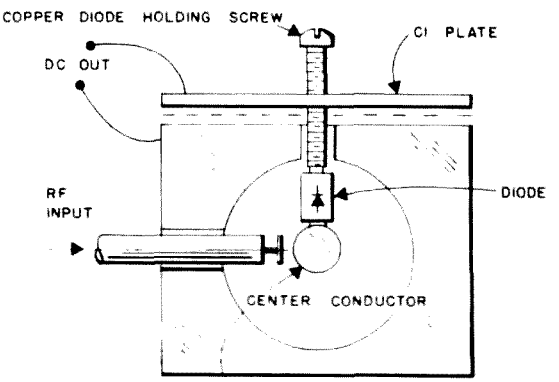


Fig. 7A. Top view of the wavemeter-receiver for 3500 MHz.



Dig. 7B. Wavemeter-receiver, 3500 MHz, inner view.

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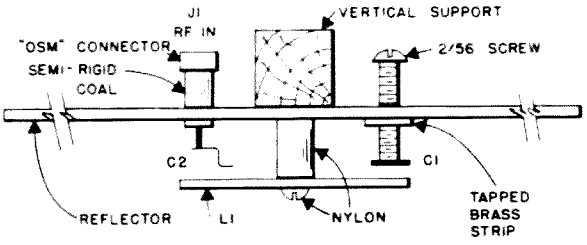


Fig. 8. Test antenna for 3500 MHz. L1 is a copper strap, 1 9/32" long by 1/4" wide; distance of C2 from center is 5/16"; spacing L1 to reflector is 3/16"; reflector size is 4 1/2" by 2 1/2".

out at all, although I could see by the collector meter that it was oscillating strongly. All of a sudden the center of the connector fell out in my hand. I unsoldered it, pushed it way in tight, resoldered a pickup loop back on, and wham over to the pin went the meter. It happens!

Have fun with this one, too, if you can afford it. I can't really myself, so will stick to 432, 1296, and maybe pulse on 2300 mHz for now.

Frequency Measurements With The Interferometer

Admittedly, in order to make frequency measurements by this method you need an oscillator, receiver, and two antennas. And in order to have these you need a frequency meter. Cheer up, it's not quite impossible. The main purpose here is to start you off with just those items. With the dimensions given you will be able to tune up somewhere near the desired band and then by using the simple interferometer method described you can put your oscillator near the middle of the band and go on from there.

The interferometer itself dates from several hundred years back, long before Maxwell or Hertz, and has some good solid basic features to recommend it.

1. It measures the length of your oscillator's waves right out in the open air which, although not precisely a vacuum as in free space, is so close in wavelength that you or I could not possibly check the difference.

2. Thus you do not have a wire velocity factor to account for.

3. You can perform this measurement right on your bench-top.

4. For equipment all you need besides the oscillator, receiver, and the two antennas, is a couple of plane sheet reflectors which can be 10 x 10 in. aluminum chassis, or similar, standing on end on the table, a 10¢ plastic ruler, and the frequency-wavelength chart of Fig. 10.

Steps to follow

1. Set up as shown in Fig. 9, "Frequency measuring setup for 432, 1296, 2300, and 3500 MHz."
2. Put reflector A and B in the same plane and about 3 or 4 ft from the transmitter and receiver, which should be close to each other but pointing toward the reflectors.
3. If you're using some power and your receiver is sensitive enough you may need some nonreflecting material between the T and the R. Normally you don't, but it's handy to have around anyway.
4. Set up the T and the R so that an equal amount of power falls on reflectors A and B, and so that an equal amount of power comes back to R, the receiver. You can tell when this is so by a good sharp null on the receiver meter when operating.
5. Leaving A fixed, move B toward T and R keeping its surface parallel with that of A. At the half wave point there should be a deep null with R's meter dropping to zero.

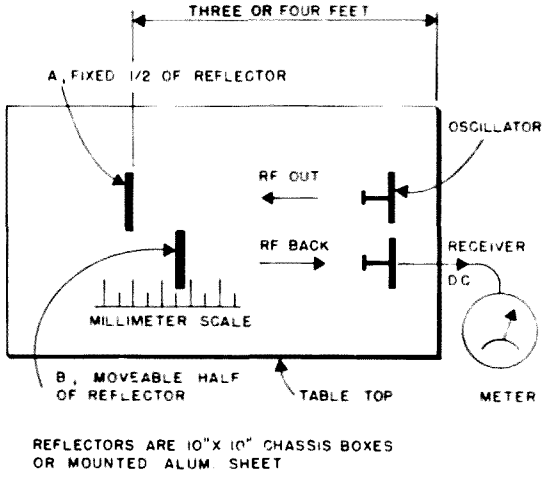


Fig. 9. Frequency measurement setup and interferometer details.

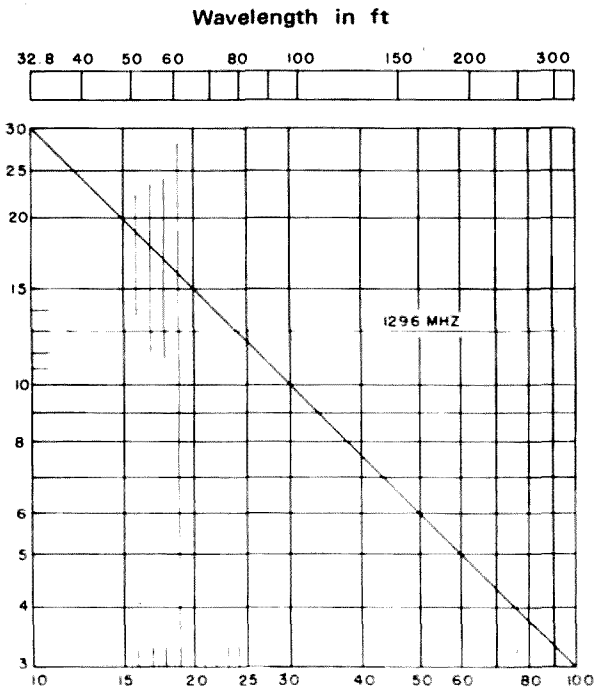


Fig. 10. Chart illustrating the wavelength frequency conversion.

6. Repeat the process several times, continuing to move B a number of half waves toward T and R, taking millimeter readings along the scale at each null.
7. The average spacing between nulls, in millimeters, will be the half wavelength. Convert to frequency with the chart of Fig. 10, or use a conversion factor if you wish. For instance the frequency in cycles per second equals 300,000,000,000 divided by the wavelength in millimeters. For example, 10 centimeters, which is 100 millimeters, equals 3,000,000,000 cps, or, 300 MHz, or 3 GHz. That's it. Happy millimeters.

Just about everything has been said, for a room-type start on solid state amateur UHF and microwaves for the average amateur to get going, and, as soon as he converts to a superhet receiver, work long distances from those hilltops with just a lantern battery for power. Think about interstate relays using this method.

An interesting feature of these bands is the geographic separation provided by two sharp high gain beams, from 23 in. dishes, pointed at each other. Who can butt in?

. . .K1CLL

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BALUN UP or BALUN DOWN?

The use of the balun, now that these are available in small and fairly inexpensive forms, is becoming more and more common, and the question of whether the balun should be placed in the center of the driven element itself and the feed line from there on consisting of a coax, or whether the antenna should be fed with twin lead and the balun used at the bottom in the shack, becomes a question of some importance.

It might, therefore, be worth analyzing the advantages and disadvantages of the two systems. Figure 1 shows the balun at the top in the antenna itself. There are two advantages to this setup: 1) Simplicity, it eliminates the central insulator in wire antennas, and does not require the 72Ω feed line; and 2) The feed line can be made less lossy, as the best air-spaced coax has lower losses than 72Ω twin lead.

The disadvantages are in weight and weatherproofing. The balun with the weight of the coaxial cable usually weighs down the center of the driven element, so that it appears more as Fig. 2 than Fig. 1. It puts additional strain on the supports and, above all, lowers the center of the antenna, which, in most antennas using half wave driven elements, reduces the efficiency. Where the center can be supported independently (by a third pole or a conveniently placed tree) this factor does not apply. In the case of the inverted V which is supported in the center, obviously, this certainly does not apply.

If the balun is placed at the top in all the weather, it must be very thoroughly weatherproofed. This is especially important where the coaxial cable is connected to the balun. Not only will any water from rain, or snow, or ice which can seep into the joint, go down into the airspaced coaxial cable, but also corrosion can soon develop in the

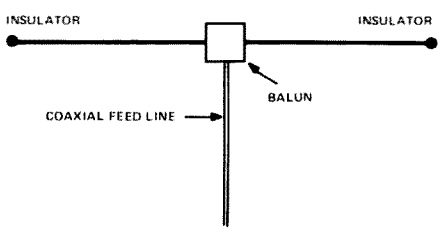


Fig. 1. The balun at the top in the antenna itself.

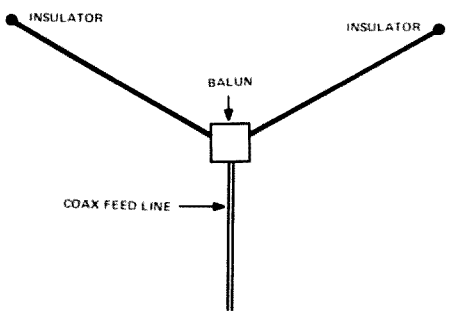


Fig. 2. The balun with the weight of the coaxial cable usually weighs down the center of the driven element.

connectors themselves, involving either frequent inspection and maintenance, or poor connections, giving rise not only to lower efficiency but, above all, to TVI problems.

Figure 3 shows the balun at the bottom, in the shack. In this case, if no central support is used, the central part of the antenna will be higher due to less weight in the center. This can increase efficiency noticeably where half wave driven elements are used. There is also less weatherproofing problem. The connection to the 72Ω feed line can be soldered to the element, then covered with a weatherproofing compound, and even slight water leakage is not likely to impair the soldered joint for a long time. The 72Ω line is waterproof. The balun with its connections are nicely in the dry in the shack, and no weatherproofing problem exists. It is nice and convenient for inspection.

But, the feed line if long can give greater attenuation. The best airspaced coaxial cable is definitely less lossy than 72Ω twin, and in the case of beams designed for 52Ω feed line, there will be a mismatch of 52 to 72, or, roughly 1.4:1 SWR. (In the case of beams, of course, the weight of the balun can be supported on the mast, though the weatherproofing problem remains.) Except in the case of beams designed for a 52Ω impedance many antennas, like dipoles, show impedances nearer 72Ω than 52Ω, in these cases an improved SWR may be achieved.

Apart from the advantages and disadvantages mentioned above, there is another problem worthy of consideration, namely TVI.

Theoretically, a coaxial line has its outer braid grounded and should, therefore, be incapable of radiating. This applies, of course, only if the SWR is 1:1 which it can only be at one spot frequency.

Furthermore, a conductor which grounded, is no longer grounded once one has travelled a quarter of a wavelength from the grounded point. In practice, this means that few outer conductors of coaxial cable are truly a ground potential for their entire length.

When I mentioned SWR of 1:1, I referred, of course, to the fundamental. How

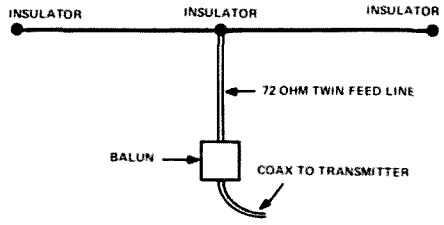


Fig. 3. The balun at the bottom, in the shack.

many feed lines show a 1:1 SWR at a harmonic frequency? Here is where a TVI problem may be created. If the outer conductor of the coaxial cable is hot to rf at the harmonic frequency, it may well radiate and cause TVI.

In the case of a twin line, the current in one leg is 180° out of phase with the current in the other leg, and they thereby cancel one another. This applies equally at the harmonic frequency as it does to the fundamental. So that the twin line gives the advantage of cancellation of any radiation from the feed line.

Of course, only in theory are the currents in the two legs of twin feed *exactly* equal and 180° out of phase. But in most cases, in practice, this is near enough effectively to reduce any radiation at the fundamental or at a harmonic frequency effectively to reduce the radiation to negligible proportions.

For the purists there is, of course, screened twin feed line – sometimes called twin coax. Here the radiation from the two legs of the twin feed line cancels out, but any slight unbalance in the current resulting in a small amount of radiation (either on the fundamental or the harmonic) is screened by the outer braid. This need not be grounded as it acts as a Faraday screen, and only has to deal with very small amounts of radiation resulting only from any possible lack of balance in the two legs of the twin line.

This screened twin feed is, however, only recommended for beams where the weight can be taken by the mast, as it is even heavier than normal coax. It is also often more lossy than unscreened twin unless very large dimensions are used. It is only mentioned here for its TVI application where I found it very effective.

In this case the balun is also at the bottom in the dry in the shack.

. . .G3BID

Another Solid State Power Supply article

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Over the last few years I've run the usual course in power for my low voltage projects. Everything from a string of D cells to a leaky wet cell under the bench, including several partially suitable ac units with and without regulation.

The main trouble is that the designs available for ac powered supplied are usually for one output voltage only. The few that have regulated output over a wide voltage range are: (1) hopelessly complicated; (2) very expensive; (3) have poor regulation characteristics; and (4) protective current limiting circuitry is not included.

After absorbing an article by W6GXN (*73* December 1966) and information published by Editors & Engineers Ltd, (*The Transistor Radio Handbook*) and several cups of coffee, here is my answer.

Before you read further though, please understand that this is not a blow-by-blow construction article. It is a basic circuit idea which may be further developed by evaluation of the contents of your junkbox.

The circuit put forward by W6GXN is that of Fig. 1. This is fine for a voltage which needs to be variable over a small range. For larger voltage excursions, such as those required when working up an experimental circuit, several problems arise. The main trouble is that D1 needs to be at least 1/2 the rectifier output voltage to provide adequate regulation at the lower settings of R2. This high D1 potential then limits the minimum voltage to approximately 1/2 the maximum output. Also, no current limiting is provided for those accidental short circuits.

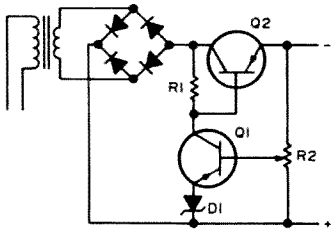


Figure 1.

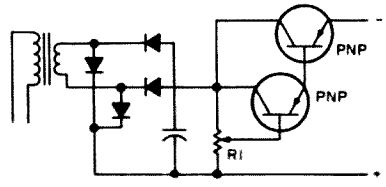


Figure 2.

Other sources propose circuitry similar to Fig. 2. This provides a full range variable output but defeats part of the idea as there is no feedback loop to provide adequate regulation under varying load currents.

Remembering Fig. 2 but going back to Fig. 1, it was deduced that if D1 rather than R2 were the variable element, a part of the difficulties would be overcome. Figure 3 was hastily thrown together to prove this point.

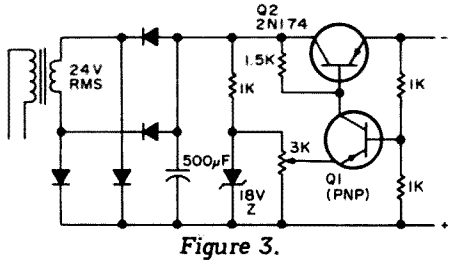


Figure 3.

As anticipated, the voltage was variable from 1.1 to 29V. For small variations in current the stability was fair but larger load changes caused a loss of regulation. At the minimum voltage settings Q1 must drop the full 30V supply across the 1.5K in its collector circuit. This current (20 mA) is put across a part of the 3K pot and thus the regulation of the emitter supply is degraded (so is the future usefulness of the pot)!

After several more cups of coffee, a few unsuccessful circuits, and a couple cooked transistors, the connections in Fig. 4 proved promising.

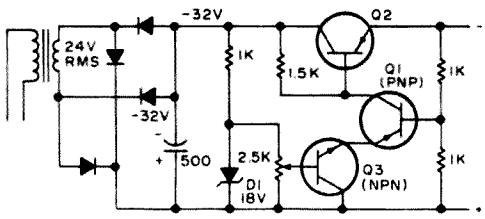


Figure 4.

Emitter follower Q3 provides a very stable regulated reference voltage for the emitter of Q1. This voltage is variable over 0.8 to 18 volts. Since the base of Q1 samples 1/2 the output of Q2's emitter, this lets us vary the output from 1.4V to the full output of the rectifier.

Extensive tests of the voltage change under load were not made but spot checks indicate adequate regulation at any set output.

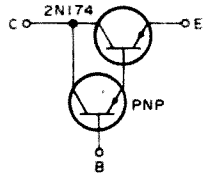


Figure 5.

Of course percent regulation is a function of the gain of your particular transistors. Another PNP might be connected to the 2N174 to make a darlington pair (Fig. 5) but this was not tried here. This would allow you to increase the resistance of the 1.5K and thus lower the current thru Q1 and Q3. It might be worthwhile if you feel a need for better regulation.

So much for the variable voltage part of the supply. Now for a simple and reliable current limiter design.

Here several circuits were tried which would provide a current sampling network and cause a voltage droop in the emitters of Q1 and Q3. All were discarded because they, affected regulation, did not limit current, or blew transistors, and/or a combination of all three!

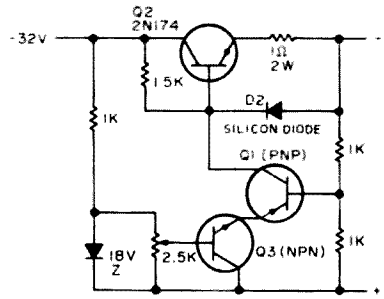


Figure 6.

Figure 6 grew out of desperation and as usual this simplest way proved to be the best.

Diode D2 is normally reverse biased by the emitter-base voltage of the 2N174. At a current of approximately 420 mA the drop across the 1Ω resistor is adequate to overcome this bias. At that point D2 conducts and limits the current flow to this level. Make that a 1Ω rheostat and you have variable current limiting.

Now as a final filter, add a 100 MFD across the output and you have 1.4 to 32V at up to 420 mA.

Other voltages could be built up with a change in transformers. Just keep the zenner at about 1/2 the total output volts.

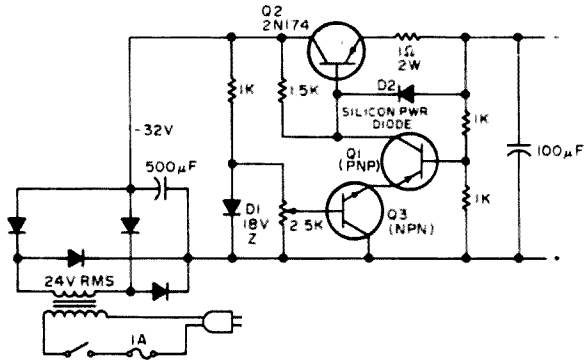


Figure 7.

Higher current could be achieved with parallel transistors for the series regulator. Here the darlington pair idea mentioned earlier might be of use. Remember to adjust the value of the current limiting resistor accordingly. The complete schematic of my supply is shown in Fig. 7, but as I stated earlier, this is a junkbox project so your's may develop significant differences.

DISCLAIMER: I cannot offer a bibliography of references for the circuitry presented here as most of it evolved from memories of various commercial, industrial, and amateur equipment I've encountered over the past 10 years. My only claim to originality is the particular component values used for my supply.

. . .K7HKL

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IC Six Meter Receiver

This is about a six meter receiver that uses a high-gain IC (integrated circuit) in the rf stage, another for the i-f, and a third for the af. If that sounds like a lot of high-gain-ICs, you're right! As I write this (happens to be 3 am), K1YNU is talking. He is in Rhode Island, a mere 105 miles airline away from here in Peterborough, N.H. For some reason – not completely figured out as yet – this receiver is extremely sensitive and you can hear everyone that comes on the band. Part of this may be the relatively broadband i-f stage. As a battery-operated complete, single conversion superhet, easy to homebrew, it certainly warrants attention, as you will see. Here we will describe the ICs used, the breadboard operation, and results. Later we will go into getting maximum selectivity with the 1.65 MHz i-f section, avc circuitry, gang tuning, packaging in miniboxes, narrowband i-f, and a companion transmitter to go with it, with several watts output.

As you can see from Fig. 1, this is a single conversion, tunable superhet. The Motorola IC HEP 590 has over 30 dB gain and is probably the main item contributing to the high sensitivity. Not having (so far) a mixer and oscillator IC, the universal (my name for them) HEP 55 transistors were used here. Another 30 dB in the i-f, with excellent gain control characteristics, is achieved by the second HEP 590.

The demodulation was given an extensive workout because this item has to be just right for DX work. The demodulation is done with a 1N295 diode, connected across a separately tuned circuit on 1.65 MHz. The details are in Fig. 7. The af is quite good, using the Amperex eleven transistor audio IC. Be sure and check the details. The 8Ω loudspeaker is a Lowell which has quite a magnet on it. It is direct-coupled to the 1W af output circuit, and contributes to the good audio obtained.

Figure 2 shows the overall schematic, which is a happy combination of two types of ICs and two discrete transistors. This unit needs gang-tuning and the narrowband i-f to make it into a deluxe receiver, but these are not difficult to add. As a breadboard unit it is extremely interesting to use and generates plenty of thinking about communication ICs and their future amateur use.

Rf Stage

These little Motorola HEP 590 IC units are beginning to show up as really amazing for rf and i-f work. The gain is high, even at 50 MHz, the noise figure is good, the freedom from feedback is as low as they

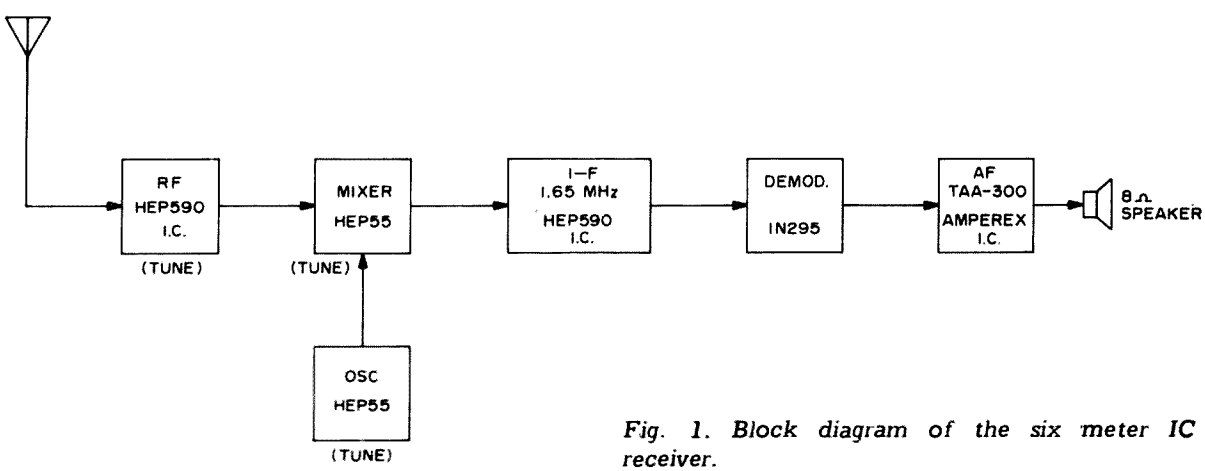


Fig. 1. Block diagram of the six meter IC receiver.

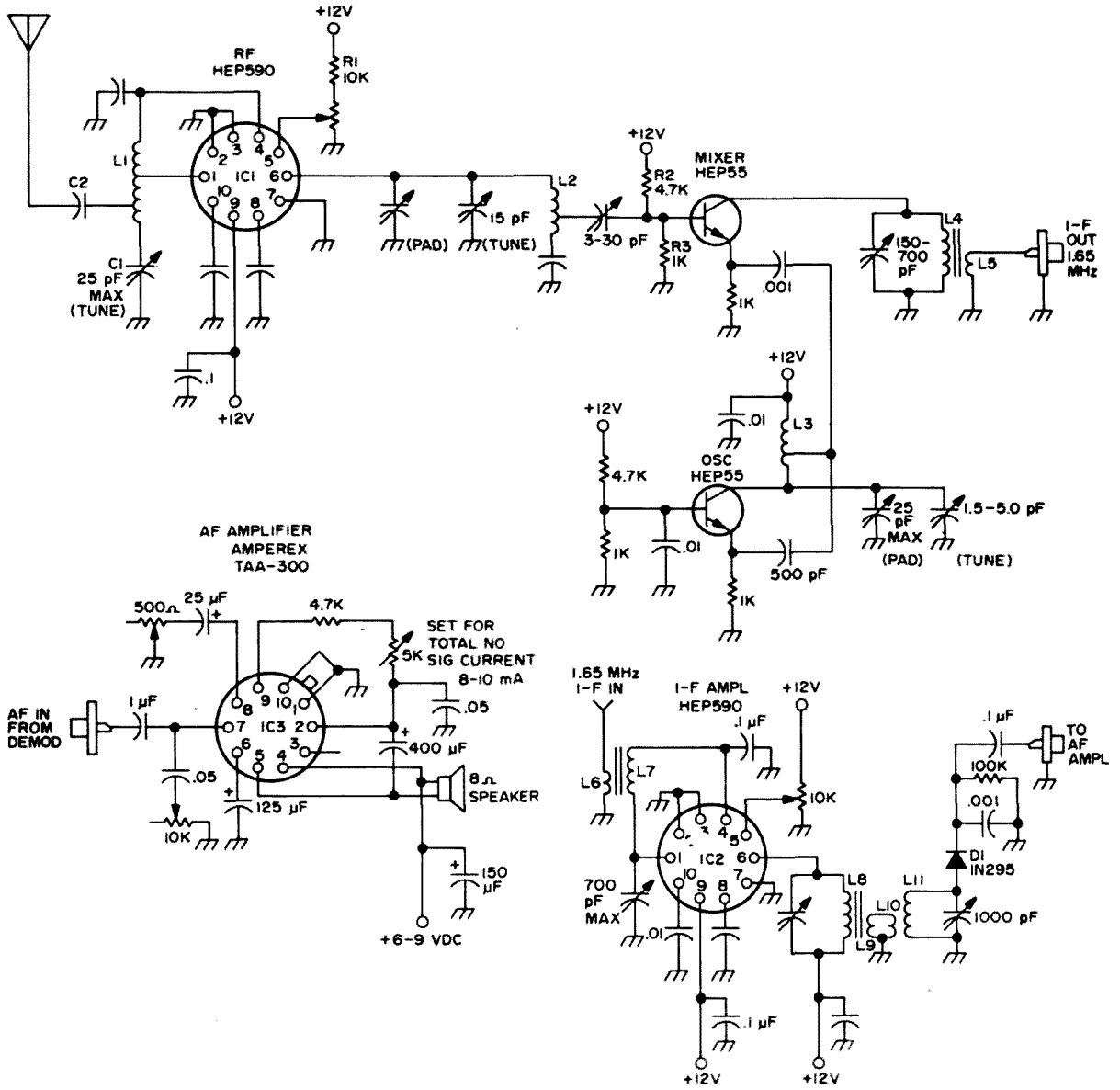


Fig. 2. Schematic.

Coil Table, Fig. 2. (All taps counted from ground [cold] end.)

L1 7 turns, airwound, 8/per in. 5/8 O.D., antenna tap at 3 turns, 590 tap at 4 turns.

L2 6 turns, airwound, 4 per in., mixer tap at 2 turns.

L3 5 turns, airwound 8 per in., tap at 1 turn.

L4 35 turns (No. 30), in Miller cup core (from No. 10c 1.F.T.).

L5 5 turns, No. 32, wound over L7.

L7 35 turns, No. 34, in Miller cup core.

L6 3 turns No. 30, wound on L7.

L8 35 turns No. 34, wound in Miller cup core.

L9 3 turns wound over L8.

L10 4 turns wound on L11.

L11, 64 turns, air wound, 32 per in., 5/8 O.D.

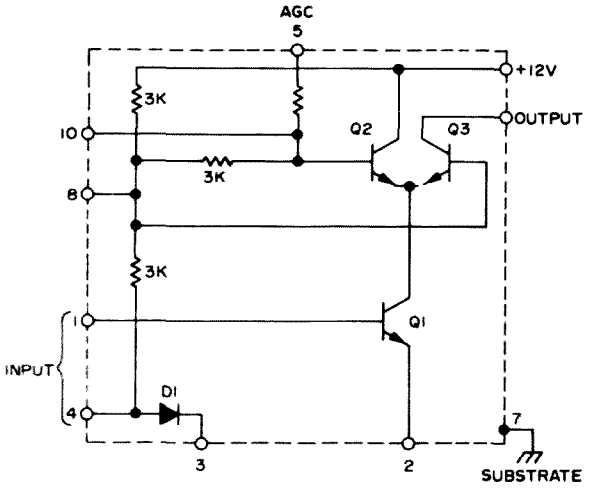


Fig. 3. Internal schematic of the Motorola HEP 590.

claim, and fine avc action is provided without distortion or detuning of the input. Figure 3 shows the internal schematic of the three transistors inside the case, which is only 3/8 in. in diameter, and Fig. 4 shows the external components.

I have been using it for some days now in front of my lab receiver while working and no spurious has shown up so far. The manual control on the avc is perfect, although you don't need it just for rf. This manual control uses the avc input line going to Q2, which is pin 5 in Fig. 2, and it is a nice thing to have in reserve when and if you tack on more i-f stages. It will be used later in its regular automatic form. It operates on Q3, leaving Q1, the input stage, in the low noise condition.

The way this is done, referring to Fig. 3, follows. The current of Q1 goes to both Q2 and Q3. With positive avc voltage on the base of Q2 (going in through pin 5) the current flows only through Q2, and Q3 is turned off with the gain of the amplifier then at a minimum. If the avc voltage on Q2 is *less* than that on the base of Q3 by at least 224 mV, all the collector current in Q1 will flow through Q3, which is the condition of maximum ac gain. Due to Q1 being on all the time, input tuning will remain constant, another advantage of the 590.

The combination of Q1 and Q3 acts as a common-emitter common-base pair and as such reduces feedback by two orders of magnitude compared to a single transistor. This of course is one of the biggest advantages of the 590 IC. All things considered, this unit is an excellent rf amplifier and an intriguing example of things to come in integrated circuits.

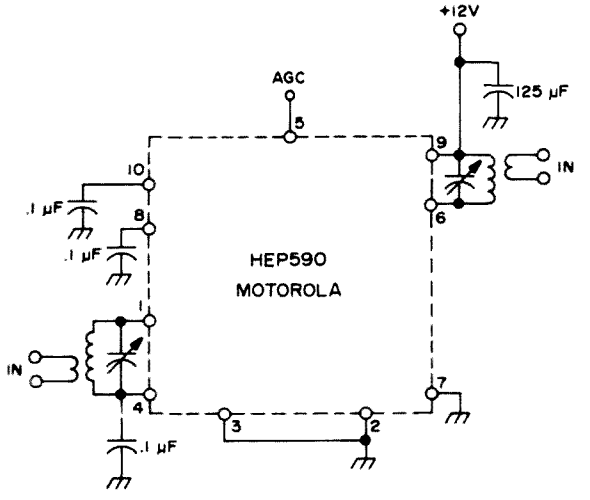


Fig. 4. External schematic for HEP 590.

The Mixer and Oscillator

These are the only discrete transistors in the receiver, and they're only in it because I haven't yet found an IC substitute for them on VHF and UHF.

The mixer circuitry shown in Fig. 5 has a minimum of components because it uses the tuned collector coil of the rf stage for its input. A capacitor over to the oscillator and an i-f output coil complete the deal.

An interesting thing about this mixer is that, while being extremely sensitive, it has not produced a single spurious so far. No birdies have been heard in several days of operation.

The local oscillator is shown in Fig 6 and is more or less standard with me because it is turning out to be very reliable.

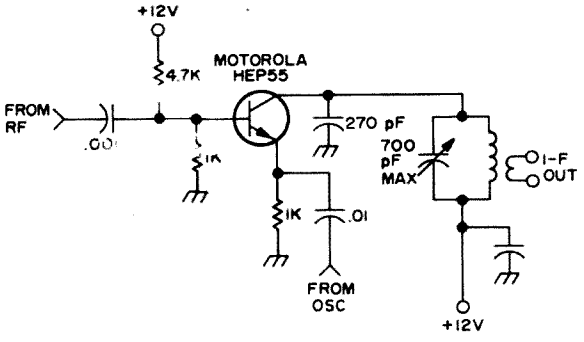


Fig. 5. Mixer schematic.

The whole inductance including the feedback portion is tuned so that considerable reserve power is available. Tap one, the oscillator emitter rf connection to L1, can be varied to suit. Right now it is less than one turn from the ground end of L1. The mixer tap is also at the same place at present, and the results are quite remarkable. I'm getting very excited about the possibilities on Two as well. Maybe it will replace the receiver of my sorely-missed Communicator Three which I *never* should have sold.

The IC I-f and Demodulator

From the way these Motorola HEP 590's worked in the rf stage, I got the idea that maybe only one of them would do for the i-f stage. It turns out that there is *more* than enough gain. You can't stay in the room with everything full on! It's really fascinating. I'm listening to Six as I write, and I can hear everyone within at least 100 miles.

The i-f details are clearly shown in Fig. 2. This i-f portion was installed on a separate copper-clad plank in order to check completely just what it could do, and it sure paid off. At 1.65 MHz there is probably more than 30 dB of gain, and so far it has never oscillated even once. Motorola claims that the "Reverse Transfer Admittance" (that old Devil feedback) is very, very, low. Here are Motorola's words, "... is extremely low since in terms of millimicromhos it involves the product of two numbers less than unity, divided by a number greater than one. Hence the fact that it is extremely difficult to measure is understandable." The figure given is less than .001 millimicromhos, therefore it can

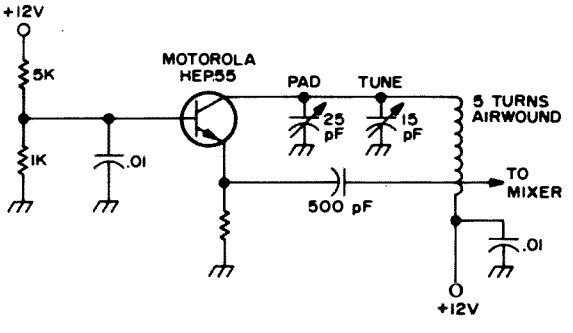
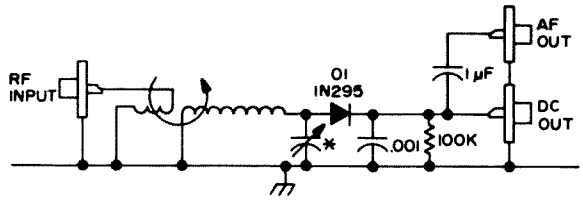


Fig. 6. Tunable local oscillator.



* 1000 pF MAX (3 GANG STANDARD BROADCAST VARIABLE CAPACITOR, ALL THREE SECTIONS TIED IN PARALLEL.

Fig. 7. Diode demodulator, 1.5 to 8 MHz. The coil data is with Fig. 2.

be neglected. So, I neglected it and no oscillation has yet occurred.

The inductors used are detailed in Fig. 2, and will be the subject of considerable experimentation in the near future. The advantages of a single conversion are important, but put a strain on the selectivity question. You need at least 1.65 MHz to avoid excessive image, and selectivity approaching 10 kHz (if you can get it) at 1.65 MHz is not easy. However, as you will see by Fig. 2, we have four tuned circuits, the mixer collector, two in the i-f plank, and the fourth in the tuned diode unit. Cup-cores from Miller 10-C tube-type i-f transformers are used for three of these, and the fourth is an air-wound job, 23 turns per inch, with about 750 pF across it. This is giving separation of some 80 to 90% of the stations on the band, and will do for the moment. There is a question of price also. Coils wound with Litz wire, that is, a number of strands of enamel wire wound into one cable such as "5/41" which is 5 strands of No. 41 enamel each, have a better Q than those wound with a single wire, but the price is a lot higher.

The i-f described here works like a charm except for a slight overlap on close stations. Another HEP 590 on 135 kHz will of course give you selectivity down to 3 or 4 kHz.

Demodulation

As you may have noticed, I like Admirable Modulation. On VHF and UHF, and up into amateur microwaves there is plenty to do, with amateur Space Stations coming up and all, without going into a bunch of up-converters and then a lot of linear amplifiers to get SSB power on those

frequencies. These present special difficulties when using solid state, to end up with modulation which does not even enable you to recognize your best friend's voice. Just my opinion, so I'm stuck with it for now. Anyway, AM demodulation circuits can sometimes give you trouble, especially when combined with avc, so let us take a look.

The circuit shown in Fig. 7 is an old-timer, but very valuable for certain types of work such as i-f amplifiers. It has its own "plank" and dial and is calibrated from about 1 MHz up to near 8. It is an excellent reference point for audio quality to start with, allowing a check into the BC band when needed. This is not to say that all those high-end BC stations are Hi-Fi! It adds another tuned circuit to the i-f for increased selectivity, allows you to check for yourself the desirable values of C2, C3, and R1, and has a dc output for metering small improvements in gain. It will be built into the i-f strip later, when the exact inductors, capacitors and resistors are determined.

The Audio IC

Figure 8 shows the internal circuit of the Amperex TAA-300 audio integrated circuit. The external circuitry is clearly shown in Fig. 2. This tiny 3/8 in. diameter can contains no less than eleven transistors and five diodes, and has been engineered to

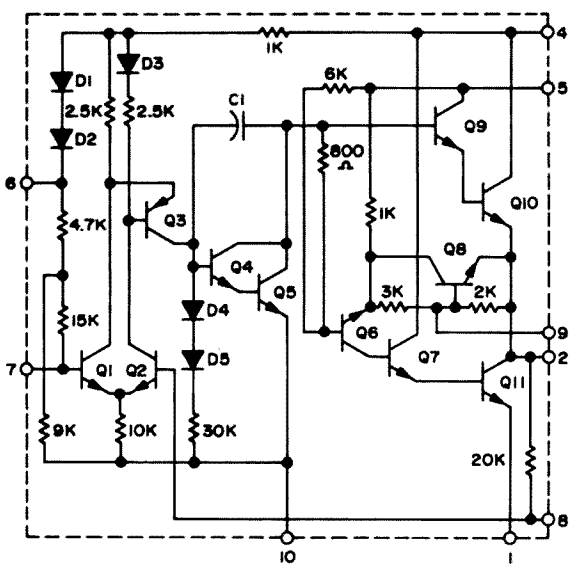


Fig. 8. Internal circuit of the Amperex TAA-300 audio IC one watt amplifier.

put out a clean watt of audio energy from 20 Hz to 25 kHz, which it does, I can assure you. It has negative feedback which can be made variable by the use of the pot attached to pin 8. Checking the internal circuit shown in Fig. 8 you can see that pin 8 is the base of Q2 and the 25 mF capacitor bypass would shunt the feedback to ground if the pot were not in series with it. With this pot at zero ohms the amplifier gain is very high, and with it at maximum there is a lot of feedback, which cuts the gain down but increases the quality of the audio. For a fixed value, Amperex recommends 47Ω.

A high frequency cutoff control is used at the input because for communications work you do not need 25 kHz response. You can also cut down on the lows because for communications you don't need 20 Hz either! Reduce the value of the input capacitor on pin 7.

Shunt pin 4, the dc input, with at least 150 mF, and run a .05 to ground from pin 2 to remove high frequency instability from the lower of the Darlington pair, Q11. Keep the input and output leads apart, preferably using shielding on the input. Use an 8Ω speaker for the best match to the transformerless output circuit. This unit is actually as claimed, a "Miniature Hi-Fi Amplifier," if you're interested in such. I am very impressed with it.

Running this receiver "as is" without the narrowband i-f following, I can repeat that some 80% of the stations will be QRM-free. Also, this figure may be increased later when I really get into the selectivity bit on 1.65 MHz. Further, rotating the beam would help cut down QRM.

If you take the time to gang the three tuning capacitors, package the whole set in one (or more) boxes, add a narrowband i-f strip, and make up a good solid state transmitter to go with it, you will have an excellent portable, mobile, and emergency rig.

If you use it "as is" you will be surprised at what you can hear on Six. It also can give you an instant check on band openings if you leave it hooked up with its own little battery. ...K1CLL

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A Tracking FM-AM Demodulator using an IC

This is the second of two articles, on the use of the phase-lock loop as an FM/AM demodulator.

The circuit to be described uses the Signetics Corp. NE561B IC and is based on Signetics' application notes. Besides providing demodulation of the FM component of a signal and perfect afc tracking of that signal, provision is also made for the synchronous demodulation of the AM component of the signal.

A block diagram of the NE561B is shown in Fig. 1; the portion enclosed in the dotted outline is in addition to the basic phase-lock loop already described. The AM input is taken before any limiter in the main receiver and its phase is shifted 90° with respect to the FM/rf input. This is necessary to have the correct phase relationship between the AM signal and the VCO input to the multiplier.

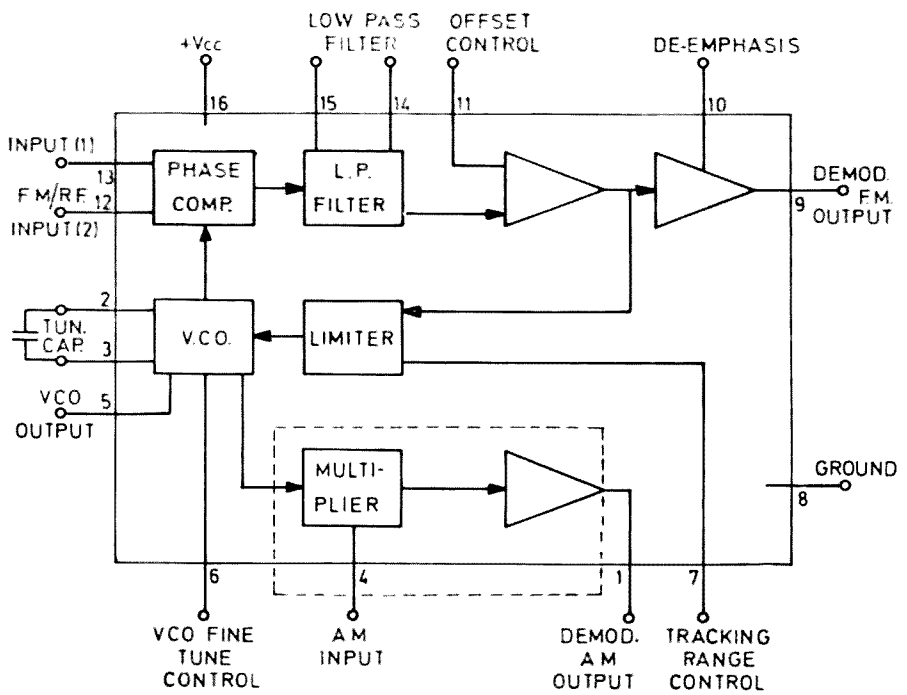


Fig. 1. Block diagram of NE561B.

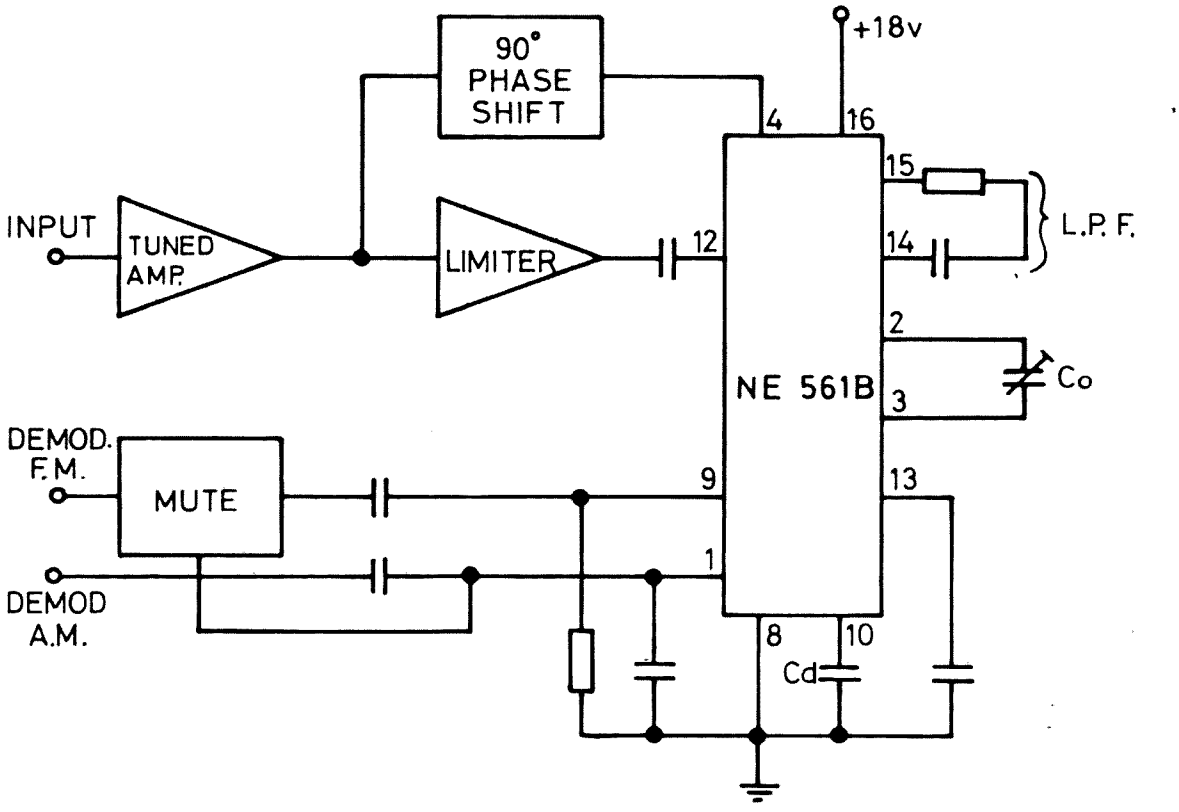


Fig. 2. Basic demodulator.

Shown in Fig. 2 is the basic demodulator. With reference to Fig. 1 we have the limited FM/rf input applied between pins 12 and 13, phase shifted AM input applied at pin 4, the VCO frequency determining capacitor (Co) connected between pins 2 and 3, the external components of the low pass filter between pins 14 and 15, and the FM de-emphasis capacitor (Cd) connected between pin 10 and earth. The muting function is accomplished by use of the output of the AM detector to open an audio gate in the presence of signal input.

The circuit diagram for the complete demodulator is shown in Fig. 3. Circuit functions can be most readily seen with

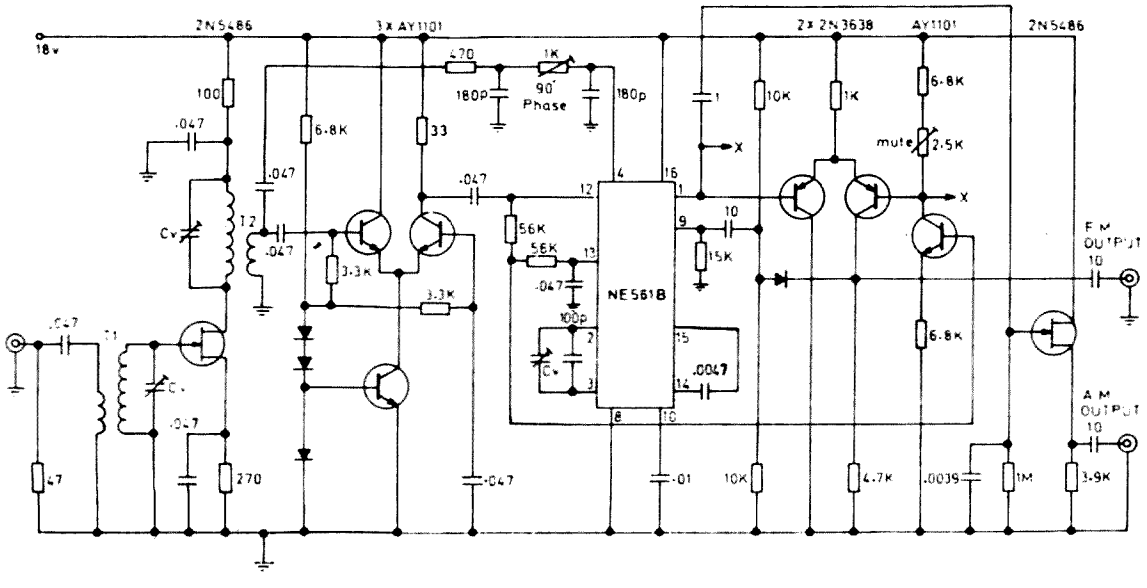


Fig. 3. Phase-lock demodulator.

reference to Fig. 2. The design centre frequency is 2 MHz, but the NE561B will function from less than 1 Hz to more than 15 MHz. Input signal is amplified by the 2N5486 JFET which is wired as a simple tuned amplifier at the required i-f. Three AY1101 transistors are used in the limiter, while the 90° phase shift is provided by an adjustable RC phase shift network.

Muting of the FM output is performed by the use of a suitably biased diode as a series gate. When no signal is present, the diode is reverse biased by the 2 x 2N3638 emitter coupled pair and when signal is applied the output from the synchronous AM detector causes the emitter coupled pair to forward bias the diode and allow signal through to the FM output.

The AY1101 transistor is used to set bias levels relative to those of the IC. AM output is taken from pin 1 via a JFET source follower; an MPF102 would be suitable for this function. The AM detector can also be used to give an indication of signal strength. A suitable circuit is shown in Fig. 4.

If operation at some i-f other than 2 MHz is desired, (e.g. 455 kHz) it would be necessary to change the resonant circuit in the JFET amplifier, change the VCO timing capacitor Co (e.g. 600-800 pF) and the 90° phase shift network (e.g. 2.2K, 5K pot., 2 x

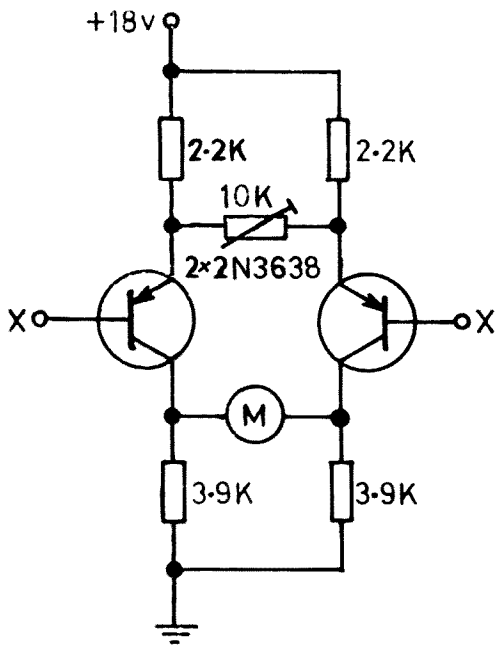


Fig. 4. Signal level indicator.

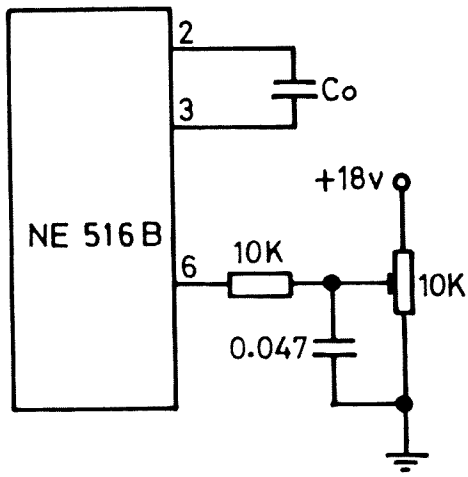


Fig. 5. Alternative VCO fine tuning.

150 pF). If a frequency less than 500 kHz is required, consideration could be given to the NE565 which will function as an FM/PM detector but does not provide for AM detection and consequently muting.

An alternate method of fine tuning the VCO is shown in Fig. 5 in which current is injected into pin 6 of the IC. A change of +12% is possible for an input current of 1 mA. This method of fine tuning will also affect the tracking range of the demodulator.

This completes the description of the phase-lock demodulator.

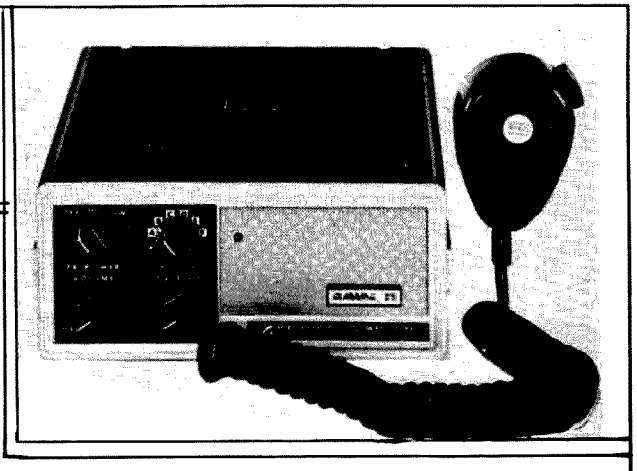
Such a unit as has been described in this article is in use in a satellite tracking receiver used for monitoring navigational and weather satellites. The principal use of the phase-lock type of detector for this application is the automatic tracking of the Doppler shift of the signal which is as much as ±4 kHz at the frequencies used.

When the proposed amateur satellite with the active repeater on 432 MHz becomes operational, Doppler shift of at least ±10 kHz will be experienced on the received signals from the satellite. It will therefore be necessary for stations receiving the signals to provide some form of tracking of the signal frequency. If such a tracking filter/demodulator as the one described in this article is used, the receiver bandwidth must be the signal bandwidth plus 20 kHz to allow for Doppler shift.

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W7DXX/1 (continued from page 128)

out of band it's rather difficult for 6 stations to sneak across 10 kHz. The other evening I was tuning across the high end of 20 SSB looking for a clear spot. My sked called for the first clear spot below 14.350. As I tuned between 350 and 340 I was amazed at the lack of activity. "Maybe this is not the QRM capitol of the world after all," I thought. So, I picked a spot just inside 14.350 and gave my friend a call. He came right back. As it happens quite often, after we had been talking about 5 minutes someone broke in and joined us, then someone else, and then still another until there were six of us having a nice round-table QSO. I pulled out the old trusty 10 minute timer so that identification went like clockwork. (No pun intended.) After a half hour or so, it suddenly hit me. I had been looking at the wrong VFO dial. I was, we were, all six of us were on 14.360. I didn't really know what to do or say. My first reaction was to say, "Well fellas, I'd better get back upstairs and get some work done." They could then worry about themselves. However, since I had started the whole thing it didn't seem quite right. Then too, after more than a half hour of operation at 14.360 I was sure there was a monitoring station using up a heck of a lot of recording tape on us and having a blast writing out all those citations. It occurred to me that perhaps the best way out was to "fess up" to the other guys. After mentioning the fact that we might be "out of the band just a little" we all spent another 5 minutes or so verbally trying to figure out what to do. We came up with several good possibilities. Like using our MARS calls, or just pulling our wall plugs. We finally decided that the best thing to do was to announce the fact that we realized we were in error, identify, apologize and get back into the band. This is what we did. It was sort of a one way transmission to all the FCC monitoring stations. I, as an example, said: "This is W7DXX operating portable one from Peterborough, New Hampshire. If there are any monitoring stations listening we realize we are accidentally out of band and will now QSY . . . sorry." After the whole thing was over and we were back in the band I couldn't help but feel extremely foolish. Not only for being the cause, to a degree, of six stations operating out of band, but for not really knowing what to do after finding myself in the situation. As far as I can recall, this is the first time I have ever found myself out of band. I suppose I could blame it on the new and unfamiliar equipment I was using. However, no citations have been received by any of the five participants so maybe we did the best thing after all. What do you do when you find yourself out of the band . . . Got an answer?

. . .W7DXX/1

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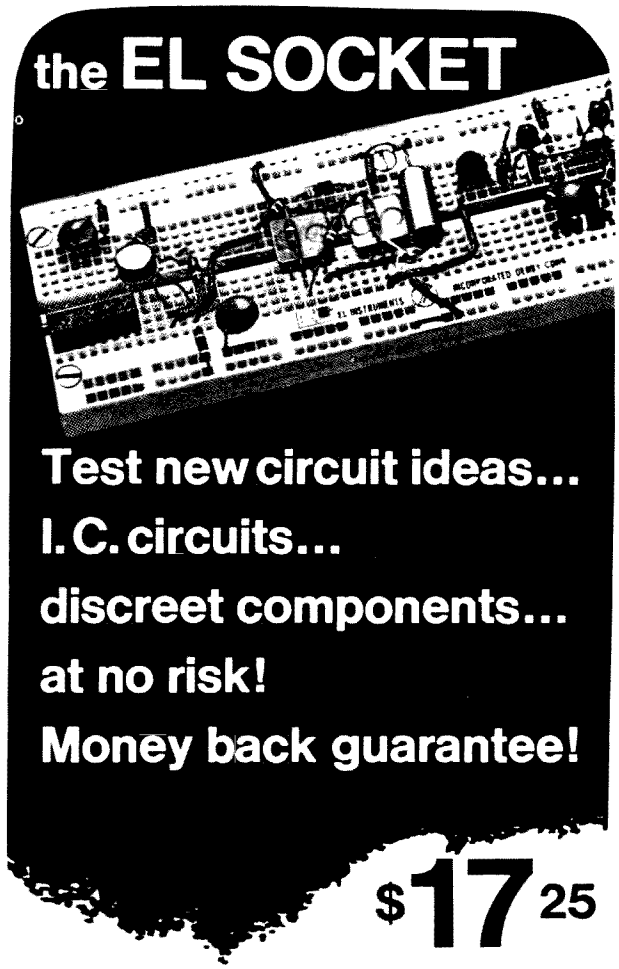
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AUSTRALIA	14	14	7B	7B	7	7	7	7	7B	7B	14	14A
CANAL ZONE	14	7A	7	7	7	7	14	14	14A	21	21	21
ENGLAND	7	7	7	7	7	7B	14	14	14	14	14	7B
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INDIA	7	7B	7B	7B	7B	7B	14	14	14	7	7	7
JAPAN	14	7A	7B	7B	7B	3A	7	7	7	7	7	14
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PHILIPPINES	14	7B	7B	7B	7B	3B	7	7	7A	7A	7	14
PUERTO RICO	14	7	7	7	7	7	7A	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7B	14	14	14A	21	21	21	14
U. S. S. R.	7	3	3	7	7	7B	14	14	14	14	7B	7
WEST COAST	14	14	7	7	7	7	7	14	14	14	14	14A

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ARGENTINA	14	14	7B	7	7	7	14	14	14A	14A	21	21
AUSTRALIA	14A	14	7A	7B	7	7	7	7	7B	7B	14	14A
CANAL ZONE	21	14	7	7	7	7	7A	14	14A	21	21	21
ENGLAND	7	7	7	7	7	7B	7B	14	14	14	14	7B
HAWAII	14A	14	7A	7B	7	7	7	7B	14	14	14	14A
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CANAL ZONE	21	14	7	7	7	7	7	14	14A	21	21	21
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ACTIVE FILTER DESIGN AND USE PART III

In Parts I and II basic LC filters were developed into active filters utilizing transistor amplifier stages and RC circuits. In this process, we showed that the bulky inductor, or indeed any inductor, was not only unnecessary, but in most cases a hindrance to design and stability. The use of transistor amplifier stages with network selectivity determined by feedback components presents a flexible mechanism adaptable to any filter requirement. One of the main advantages of the active filter is the replacement of high insertion losses normally associated with LC filters with little or no insertion loss and, in many cases, overall gain. At the lower frequencies, inductors become quite lossy and good circuit Q's become more difficult to obtain. Substituting gain stages for these unwieldy components allows the designer to set a value of Q optimum to the desired response.

In spite of the many advantages of transistorized active filters over the passive LC types, there are also some disadvantages. Due to the problems of impedance matching input and output of transistor stages, utilizing a minimum number of components requires that the transistors be incorporated in an emitter follower configuration, thus limiting gain to unity. Naturally, if the number of components, or expense, was not important, design would be somewhat simpler and the resulting response somewhat better. Recent advancements in integrated circuit manufacturing processes have managed to bring the average cost and availability of these components within the reach of the amateur and provide a means of improving the performance of the active

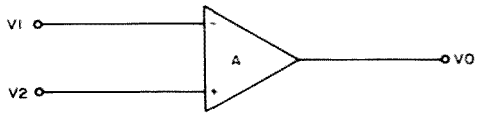


Fig. 1. Operational amplifier.

filter while retaining the low cost of the simple transistor version.

One of the most versatile of the integrated circuit family is the operational amplifier. The ideal operational amplifier is basically a two-input, infinite gain, voltage-controlled voltage source. Figure 1 shows the symbolic representation of the operational amplifier. The output voltage, Vo will always be of the same polarity as the voltage at one of the input terminals and of opposite polarity to that of the other input terminal. Output level is a function of input level and gain of the amplifier:

$$Vo = A(V2 - V1)$$

In considering the use of operational amplifiers as active components in a filter network, there are many advantages to be noted. An increase of reliability is possible due to the closer matching of active and passive components and temperature stability of these components mounted on a single substrate. An additional advantage is evident in reduction of size, weight, power consumption, and cost of a similar passive network.

Unfortunately, the practical operational amplifier is a non-ideal device, the voltage gain of which is highest at dc, decreasing as frequency increases. Naturally, it has a finite input and output impedance and a stability factor which may require negative feedback to preclude oscillation. Stability is normally no problem when utilizing the operational amplifier as an active filter element since the

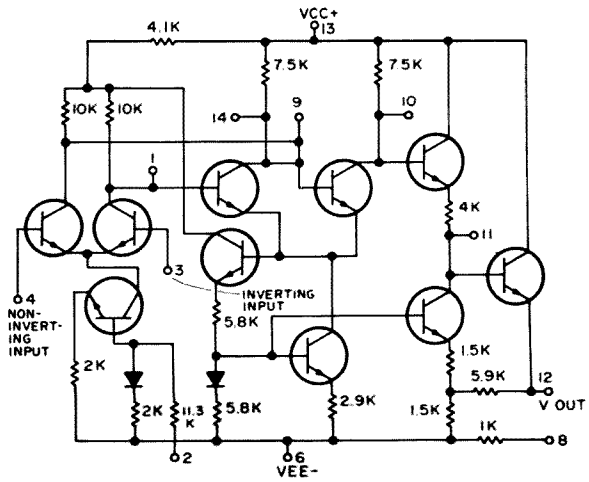


Fig. 2. RCA CA3030 operational amplifier.

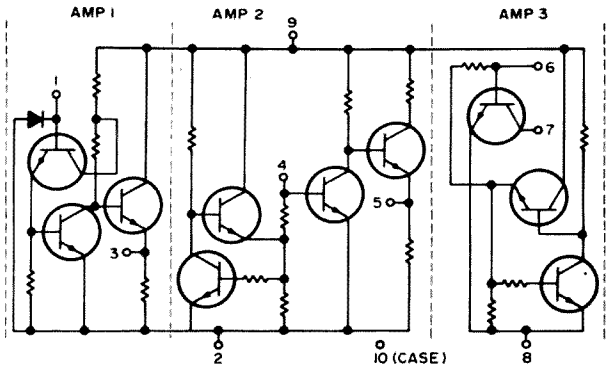


Fig. 3. RCA CA3035 linear amplifier.

outboard frequency compensating components will also serve to make the circuit independent of unstable response, temperature variations, and power supply fluctuations. Referring to Fig. 1, the input labelled V1 is known as the inverting input and any signal inserted here will be 180° out of phase at the output. On the other hand, V2 is a non-inverting input and will not produce a phase shift at the output. The notation "A" indicates open-loop gain of the amplifier without external components. Although either input can be utilized as the signal source, the inverting terminal has the advantage of allowing more gain and attenuation of unwanted frequencies. This is especially true in the low pass filter configuration where the feedback capacitor originates at a low impedance output point.

The input stage of the operational amplifier consists of two transistors connected to form a differential amplifier. The RCA CA3030 operational amplifier in Fig. 2, shows the two input transistors connected back-to-back. This configuration provides a high input impedance and allows the offset (signal level above dc base) to be adjusted via the "no-signal" input terminal. The input

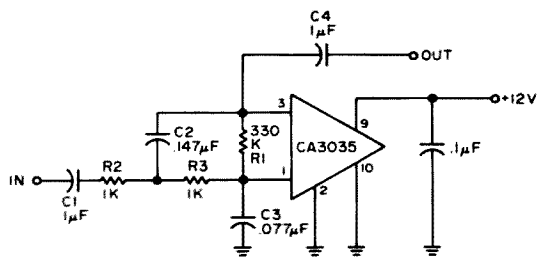


Fig. 4. 2-pole low pass with linear IC.

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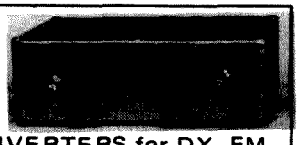
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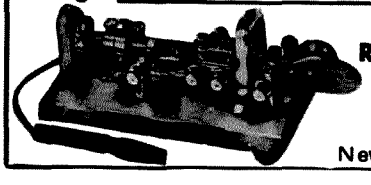
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differential amplifier is followed by voltage gain stages which raise the signal to a high level. Various terminals are brought out of these voltage gain stages to allow frequency compensation. The final stage of the amplifier is a low impedance output in the form of a push-pull emitter follower which provides freedom from loading which might affect the desired frequency response. Since the operational amplifier is a bipolar device, it will amplify both positive and negative voltage swings. Although some integrated circuits may be used with single polarity power supplies, by additional circuit modifications, it is wise to use positive and negative supplies with a common ground, as recommended by the manufacturer.

In utilizing integrated circuits for active filter design, there are a number of new problems which are not so apparent in transistorized filters. First of all, with integrated circuits we have a number of transistor stages, with their associated components in very close proximity to each other on the same physical base. Consequently, freedom from internal feedback becomes an important factor. Similarly, external frequency determining components must have short leads and, in some cases, be physically oriented to prohibit stray pick-up. Secondly, circuit stability is dependent on gain and loading among other parameters. As an example, failure to match the low output impedance of the integrated circuit will tend to change the frequency response of the filter, increase current drain, and decrease applied voltage. Using the integrated circuit in the inverting mode to obtain additional gain requires careful design of input signal range and supply voltages to preclude the possibility of oscillation. With increased gain, it is more difficult to design a filter with a sharp 3 dB cutoff point. In addition, where we could easily expect a passband flat to ±1 dB limits when working with transistor

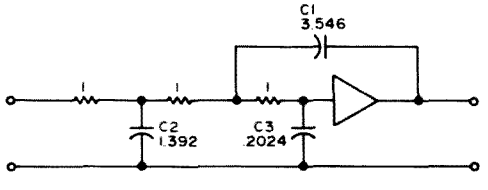


Fig. 5. Normalized low pass.

filters, we now must employ extra sections to create a flat response.

In order to estimate the passive component values for active filters, we use a network normalized for a frequency cutoff of 1 radian per second. The network shown in Fig. 4, gives the normalized component values for a three-pole filter to produce a Butterworth response. Recomputing the capacitor values, by frequency scaling for a 3 dB cutoff at 1500 Hz gives:

$$C_1 = \frac{3.546}{2\pi(1500)} = 370\ \mu F$$

$$C_2 = \frac{1.392}{2\pi(1500)} = 147\ \mu F$$

$$C_3 = \frac{.2024}{2\pi(1500)} = 21\ \mu F$$

More practical values for the capacitors are obtained by impedance scaling. In this operation, the normalized resistance values are multiplied by the desired filter impedance value while the capacitors are divided by the same figure. Utilizing a new figure of 1 KΩ provides the values shown in the network of Fig. 5. The non-inverting input of the integrated circuit should be terminated with a value of resistance equal to the impedance seen by the inverting input transistors of the operational amplifier, the value of this resistance may be much lower than the input impedance, and can best be found by substitution after the designed value frequency selective components are in place. To increase stability of the network, the inverting input is biased with a resistance determined by the level of the input signal and the gain of the operational amplifier. The RCA CA3030 operational amplifier is

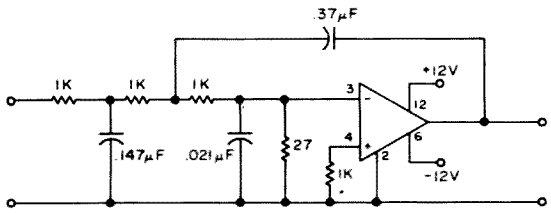
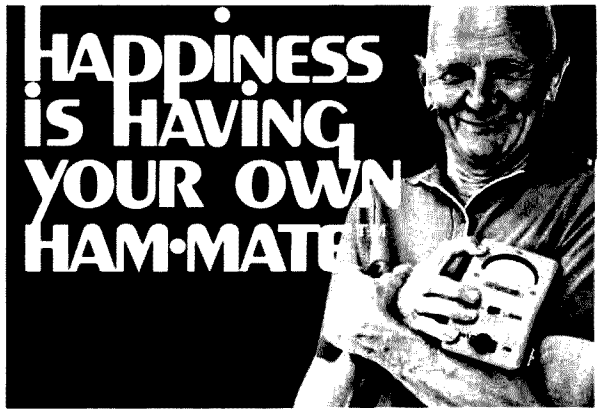


Fig. 6. 3-pole low pass filter.



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used in this low pass network as an example of a low-cost integrated circuit for active filter work. The response of this network is shown in Fig. 7a. The tolerance of the components used in this circuit was 10%. Closer tolerance components, or trial and error replacement, will bring the cutoff frequency down to the desired 1500 Hz point. The circuit exhibits gain of 7 dB indicating that higher values of network resistors might be used if it is desired to obtain more common electrolytic capacitor values. The attenuation curve is not as steep as it might be. This is mainly a problem of Q and lack of component isolation in the integrated circuit.

Normally, we would expect a noticeable increase in attenuation slope when adding filter sections. Figure 8 shows the normalized values for a two-pole filter with Butterworth response. Utilizing the same cutoff frequency, computations for the component values appear as follows:

$$C_1 = \frac{1.414}{2\pi(1500)}$$
$$= 150\ \mu F$$

$$C_2 = \frac{.707}{2\pi(1500)}$$
$$= 75\ \mu F$$

With 1 KΩ resistors:

$$C_1 = \frac{150}{1000}$$
$$= 150\ \mu F$$

$$C_2 = \frac{75}{1000}$$
$$= .075\ \mu F$$

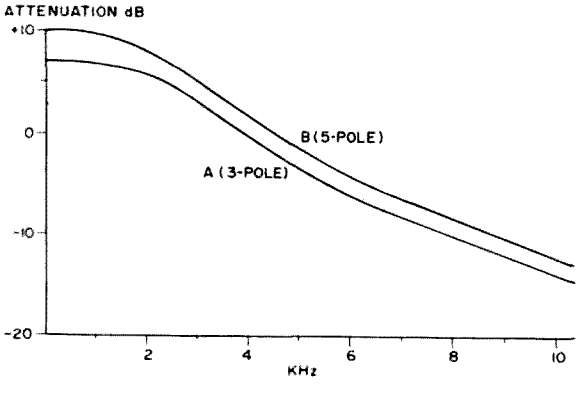


Fig. 7. CA3030 low pass response.

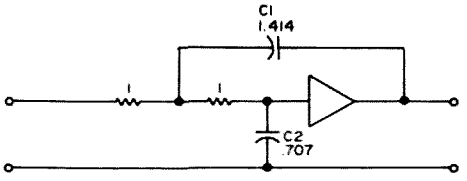


Fig. 8. Normalized 2-pole low pass.

The new two-pole configuration is shown in Fig. 9. With this section added to the previous three-pole network, the five-pole filter provides us with 10 dB gain, but, as can be seen in Fig. 7b, no additional attenuation. Thus it is not possible to vary the response curve by adding additional poles without recomputing the pole values for the entire filter. In other words, to change a three-pole network to a five-pole configuration, calculations from normalized values for a five-pole design must be made rather than adding a two-pole section. An exception to this rule exists when an RC network is added to the output to flatten the response; however, these components are not normally considered an active pole of the filter.

Although the versatility of operational amplifiers is hard to match, integrated circuit linear amplifiers are easier to adapt to filter design. The RCA CA3035 integrated circuit linear amplifier, shown in Fig. 3, is an economical, high-gain, wide-band amplifier which can be operated from a single power supply. Three separate amplifiers are housed in this TO-5 case, and they may be operated individually or cascaded for a voltage gain approaching 129 dB. Power supply voltages may vary as much as 5 to 18 volts, and each amplifier is internally temperature compensated in the range -55° to +125°

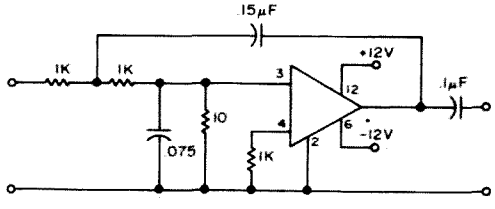


Fig. 9. 2-pole low pass filter.

Amplifier number one offers high input impedance (50 KΩ), low output impedance (270Ω), low noise, and a response flat within 3 dB from dc to 500 kHz. A diode protects the amplifier from possible damage by overloading signals.

Amplifier number two has an input impedance of 2000Ω and an output resistance dependent upon the output load resistor. This amplifier may be externally powered by a separate power supply through pin 7.

Design of a low pass filter with the RCA CA3035 IC linear amplifier is shown in Fig. 4. Resistor R1 provides a bias for amplifier number one. The second and third amplifiers are not used in this circuit. Capacitor C1 couples the signal to the active network while C4 provides output coupling. R2, C2, and R3, C3 make up the two poles of the low pass filter. The frequency response curve for this active filter is shown in Fig. 11a. Frequencies below the 3 dB rolloff are flat within ±1 dB, the attenuation curve is smooth and easily varied by changing the values of the components making up the two poles.

In many cases, a sharper rate of attenuation is desirable than that shown in curve A of Fig. 11. With a few additional components and making use of amplifier number two of the CA 3035 integrated circuit linear amplifier, the slope is easily steepened. Referring to Fig. 10, we now have a three-pole low pass active filter which lends itself well to experimental design on the workbench. The output coupling capacitor, C4 of Fig. 4, has been replaced by a 0.22 μF capacitor which, besides coupling the output

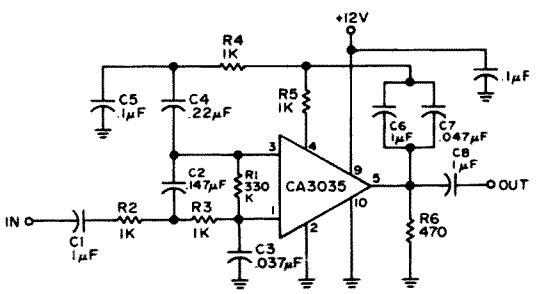
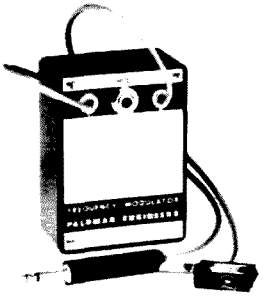


Fig. 10. 3-pole low pass with linear IC.

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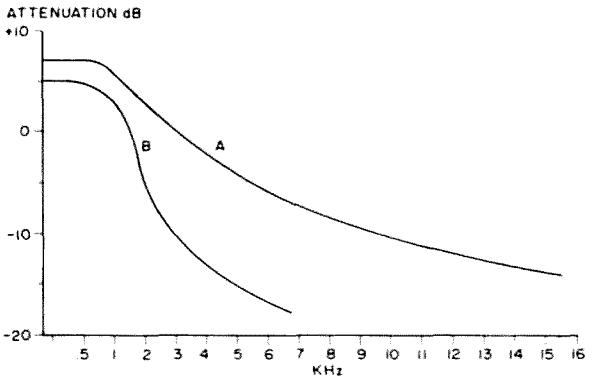


Fig. 11. Low pass response RCA CA3035.

of amplifier number one to the input of the second amplifier, also acts in conjunction with C5 and R4 as an impedance matching component. This procedure is necessary to preclude distortion and loss otherwise encountered when the output impedance is much less than the following input impedance. These components must be selected to assure faithful coupling of the signal over the entire frequency range of interest. Resistor R5 functions as part of the third filter pole in conjunction with feedback capacitors C6 and C7. Capacitor C7 has a great affect on the attenuation slope and may be varied to obtain the exact degree of slope desired. Resistor R6 also helps to match the output/input impedance of the two amplifiers and compensates for the impedance change caused by the feedback network. Curve B in Fig. 11 shows the effective increase in slope attenuation by addition of the third pole and amplifier number two. Note that the three-pole filter still exhibits a nominal gain of 5 dB. The circuit was not designed with obtaining a signal gain in mind, although the CA3035 is capable of a much greater increase in signal level. We would normally be satisfied with a

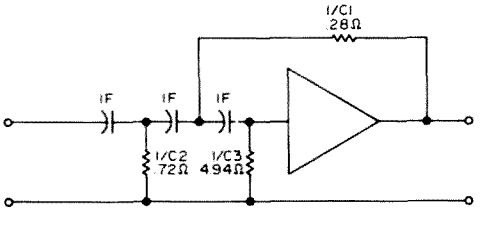


Fig. 12. Normalized high pass filter.

signal gain of unity for a filter in order to preclude possible problems with extraneous coupling and amplifier oscillation.

Figure 12 shows normalized values for a three-pole high pass filter. The values are obtained by finding the reciprocals of the normalized low pass configuration shown in Fig. 5. To achieve frequency scaling, all capacitor values are divided by $2\pi FC$. For a cutoff frequency of 500 Hz:

$$C_{1,2,3} = \frac{1}{2(3.14)500}$$
$$= 310\,\mu F$$

Impedance scaling is then obtained by multiplying each resistor value and dividing each capacitor value by a constant chosen for convenience in component selection. Using 1000 as an impedance constant, the circuit values of Fig. 13 are obtained.

From the response curve of Fig. 14a it can be seen that the active high pass filter configuration of Fig. 13 exhibits 7 dB of loss. Most of this loss could be regained by utilizing a larger value constant when carrying out the impedance scaling procedure. Utilizing the closest common value when constructing the ideal circuit of Fig. 13 accounts for the -3 dB cutoff point being about 500 Hz off of the design specification. Overall response and attenuation slope of the high pass filter is good.

The RCA CA3035 integrated circuit linear amplifier does not lend itself as well to high pass filter design as it does to low pass design. This is due, first of all, to the biasing requirements. Base bias is obtained from the B+ line at pin 3, which is the output terminal for amplifier number one. Utilizing the bias resistor in the normal fashion tends to upset the feedback network, thus altering

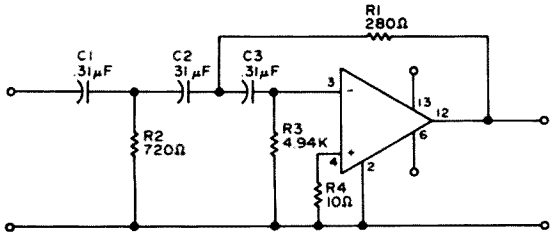
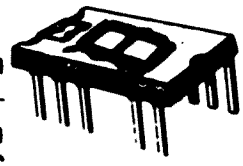


Fig. 13. RCA CA3030 high pass filter.

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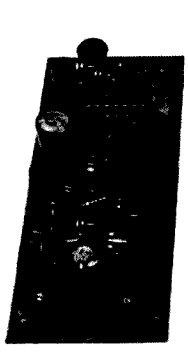
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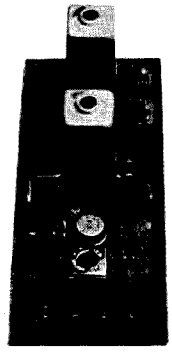
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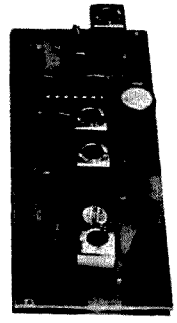
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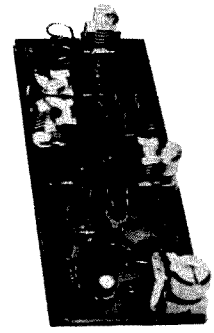
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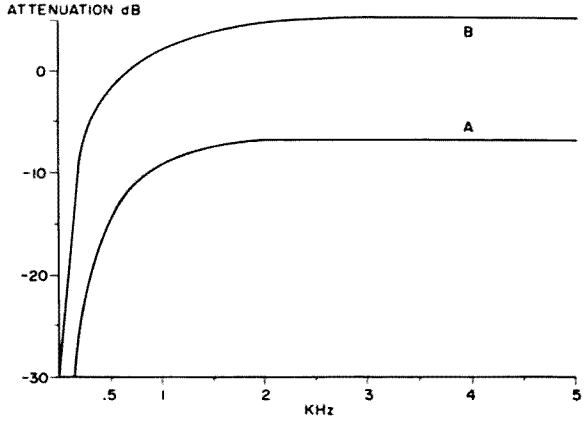


Fig. 14. High pass filter response.

the response. Placing the 5.1 KΩ resistor of the filter network from terminal number one to ground, and not adding the normal 330 KΩ bias resistor, will not permit satisfactory operation due to the diode across the input of the integrated circuit which sets the base at a certain level above ground at all times. Therefore, bias must come from the B+ line and be of a value to preclude clipping of the incoming signal by the diode incorporated into the first stage of amplifier number one.

One method of surmounting the above problems is shown in Fig. 15. For comparison, the same number and value of components has been used as in the circuit of Fig. 13. All filter network resistors have been removed from their normal shunting positions to form parallel circuits where they will not interfere with biasing. Capacitor C1 has been moved to the feedback branch where it functions as a dc blocking capacitor as well as a filter element. The response for this active high pass filter is shown in Fig. 14b. Due to the different design of this circuit, some of the component values should be changed in order to flatten the top

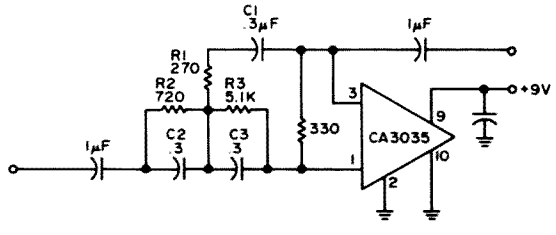


Fig. 15. 3-pole high pass filter with linear IC.

of the curve and place the -3 dB cutoff point where desired. Increasing the value of C2 and decreasing the value of C1 will make the curve more symmetrical without affecting the 5 dB gain.

Figure 16 shows a simple bandpass configuration which is capable of providing good response symmetry when utilized in a circuit with enough gain to allow small signal application. Similar to design of twin-T circuits, the component values for the bandpass may be of almost any value as long as the RC ratio is maintained. However, better results are obtained if the value of R_A is no lower than 1 KΩ. Design values may be obtained by the following formulas where BW is bandwidth at -3 dB, G is nominal voltage gain, and F is the center frequency. By way of an example, we will work out a possible design for a bandwidth of 500 Hz, center frequency of 1200 Hz, with a gain of 10 dB. As a matter of convenience, we will use 0.1 μF capacitors. Where:

$$R_A = \frac{1}{2\pi BW\, G\, C}$$

$$= \frac{1}{2(3.14)(500)(10)(.1\text{x}10\text{-}6)}$$

$$= 31.8\Omega$$

$$R_B = \frac{1}{\pi BW\, C}$$

$$= \frac{1}{3.14(500)(.1\text{x}10\text{-}6)}$$

$$= 6.3\Omega$$

$$R_C = \frac{1}{\sqrt{2\pi C \frac{2F}{BW} - BW\, G}}$$

$$= \sqrt{\frac{1}{2(3.14((.1\text{x}10\text{-}6)\ \ \frac{(2(1200)2)}{500} - 500(10)}}$$

$$= 45.2\Omega$$

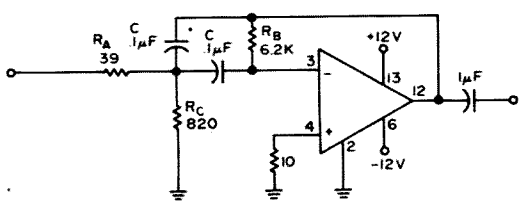


Fig. 16. Active bandpass filter.

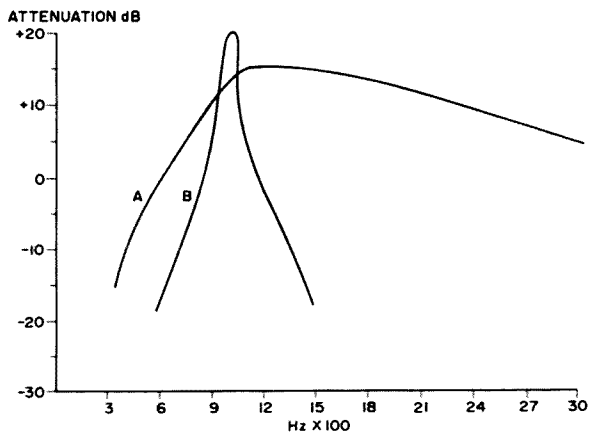


Fig. 17. Bandpass response.

The component values of Fig. 16, derived from these formulas, produce an unsymmetrical waveform as shown in Fig. 17a. Resistor R_C sets the center frequency within ±600 Hz. The change in the value finally needed over the design value indicates an asymmetrical response, as indeed we have. Changing the value of C to .01 μF will increase the value of R_A to 3.3 KΩ and R_B to 62 KΩ. A more symmetrical response will be obtained with these values.

Linear integrated circuit amplifiers are well suited to bandpass use. In Fig. 18, the RCA CA3035 linear amplifier is used in a narrow bandpass version of the twin-T configuration. Component values are determined by allowing R2 = R3 = 2 x R4. Since R2 and R3 are also used as bias resistors, their value should not be less than 150 KΩ. In addition, gain for this circuit is so high that a lower value of R2, R3 will cause a distorted response at the center frequency. The capacitors should be maintained in a ratio

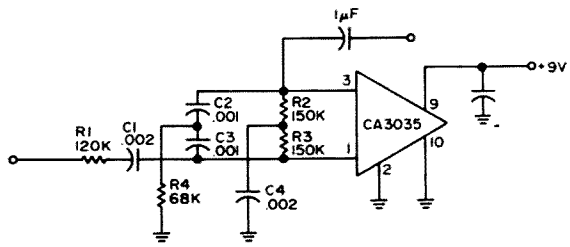
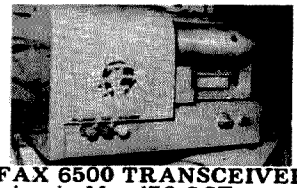


Fig. 18. Narrow bandpass with linear IC.

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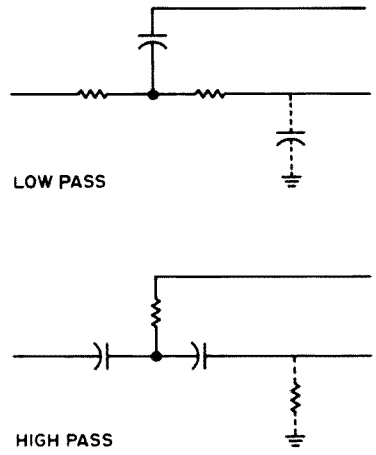


Fig. 19. Basic forms for combining.

where C2 = C3 = C4/2. Center frequency of the narrow bandpass may be found by utilizing the formula:

$$F_{RC} = \frac{1}{2\pi R_2 C_2}$$

This active filter circuit offers a high Q, which can be lowered for greater bandwidth, by decreasing the value of R1. An increase in gain is also obtained when R1's value is lowered. The symmetrical response of the filter, tuned to 1 kHz, is shown in Fig. 17b. An even greater increase in Q may be obtained by increasing the value of R1. This is done at the expense of lower gain.

Depicted in Fig. 19 are the basic RC two-pole high and low pass filter configurations. Using these basic forms in a series configuration will produce a bandpass design while a parallel configuration gives a bandstop response. Increased Q may be obtained by designing individual filters with an increased number of poles, or adapting the design to the specific requirement.

If we parallel the simple configurations of Fig. 19, disregarding components shown by

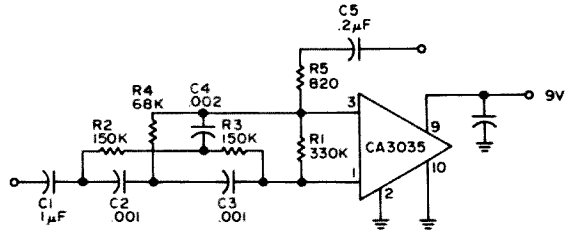


Fig. 20. Narrow bandstop with linear IC.

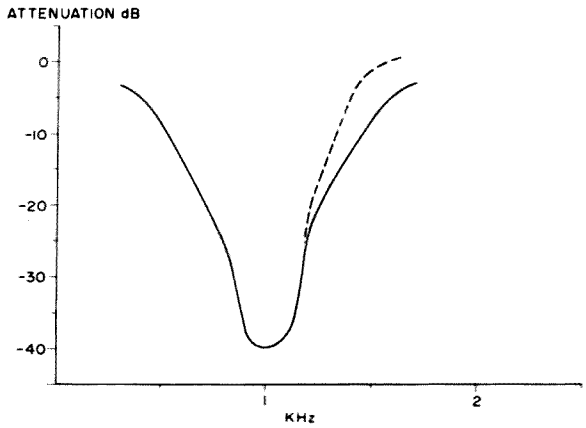


Fig. 21. Bandstop response.

dashed lines, the design takes on the appearance of a twin-T. Thus, the bandpass circuit of Fig. 18 now becomes a bandstop filter. The completed design for the narrow bandstop filter is shown in Fig. 20. Output components R5 and C5 tend to make the response of the filter more symmetrical. The response of the active bandstop filter is shown in Fig. 21. The dashed line indicates the response when a 1 μF capacitor replaces R5 and C5. Using lower values of R2 and R3 in twin-T design will tend to lower the overall Q of the filter.

From the days of the trial and error procedure of winding inductors we have now progressed to the point where a complete filter can be designed and constructed in a space no larger than the size of a quarter, and, in most cases, with better results.

. . .K3PUR

References

Active Filters: Part 12 Shortcuts to network design, Robert R. Shepard, *Electronics*, August 18, 1969.

Active Bandpass Filter, Leslie Robinson, *EEE*, February 1968.

RCA CA 3035 Integrated Circuits, R&R Electronics, 311 E. South St., Indianapolis, IN.

The Operational Amplifier, Donald E. Lancaster, *Electronics World*, August 1967.

Third Order Filters Using One Operational Amplifier, James L. Harrison, *EDN*, January 1966.

RCA Linear Integrated Circuits: File No. 316, RCA Electronic Components, Harrison, NJ.

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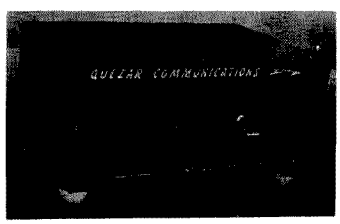
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In the last part of our VHF frequency counter series, this month we will cover the actual construction of the unit. Most of the fine details are pretty well covered by the layout drawings, and so we will keep the text itself short. When looking at the drawings, make sure to read the fine print in the notes which may explain quite a few questions.

(If you want to reduce the overall size of the counter, you can cut the board in two with a fine toothed saw, about 4 inches back from the front edge, between the two heavy copper lines running the length of the board. If you stack the rear part of the board upside down above the front part, you can connect the two without too much trouble with short wire jumpers. But make sure to use heavy wire or braid to connect the grounds of the two boards together at the ends of the two boards.)

Construction of the counter is quite straightforward, since almost all components are mounted on the main p.c. board shown in Fig. 19. This board is 7" x 10" in size, with the readouts and the two input circuits along the front (long edge) of the card so they are convenient to the front panel of your cabinet. In order to explain where all the parts go and which part of the main board has which circuit, we've broken up the main board layout into smaller sections, Figs. 20 through 26. Each of these takes one or two of the circuits shown in Figs. 3 through 10 and shows the actual layout of the parts on the board. In each drawing, a small sketch in the corner shows where to find that circuit on the main board, shown in Fig. 19.

Looking at Fig. 19, the front of the board is shown at the top, and the view is at the copper side of the board. A good way to recognize the front edge is by the five 9-pin

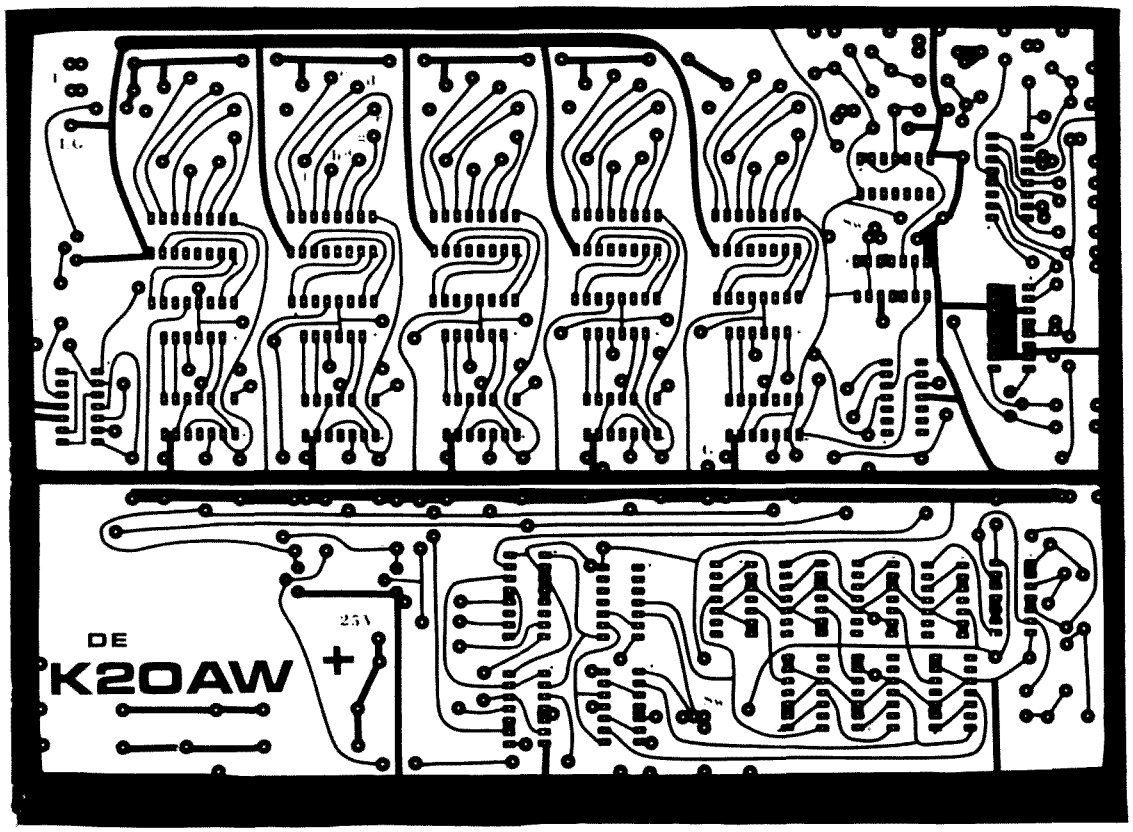


Fig. 19. Printed circuit board layout for main board (copper side, 50% actual size).

Numitron tube sockets along the edge. In each of these figures, we are looking at the copper side of the board. The components actually mount on the other side, so we are actually looking at the bottom of the board. This is important when mounting transistors and IC's.

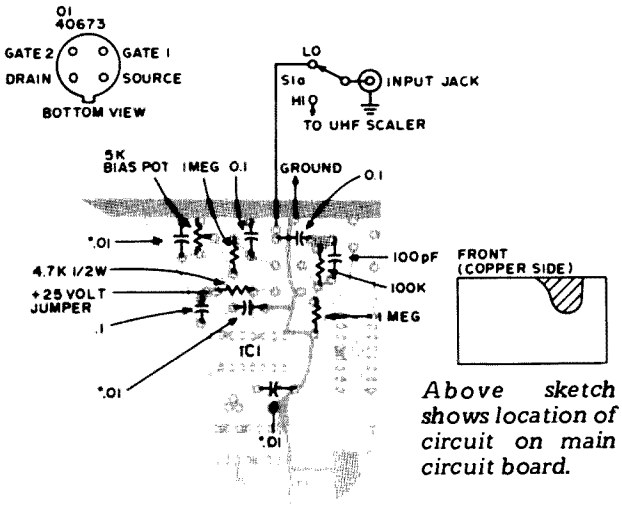
Figure 20 shows the 0–20 MHz input circuit. Transistor Q1 is shown as a bottom view at the side; the important thing to notice is the orientation of the little tab on the transistor case. Notice also that the IC's have to be inserted in a certain way – there is usually a little notch or depression at one end of the IC body, on the side that has pin 1. We have marked the position of this notched side on the drawings with a small half-moon. Furthermore, the drawings and the board have a small dot next to pin 1. Starting at pin 1, the pins are numbered consecutively down that side, and then back along the other side. IC1 is a seven-pin IC, and so it has pins 1 to 7 along one side (starting from the terminal near the dot), and pins 8 through 14 back along the other side. Pin 8 is on the same end as pin 7, and pin 14 is on the same end as pin 1. Some of the IC's have 16 pins, with pins 1 to 8 along one side, and 9 through 16 returning back along the other.

Incidentally, IC sockets of one kind or another are a must for a project like this. We don't want to scare you, but occasionally an IC is defective, or for some reason you have to troubleshoot the board, and removing an IC that has been soldered on the board is a pain in a place pills can't reach. There is also another reason for sockets, and that is that some of the IC's on the board do not have all their pins connected. In order to leave more room for connections at the bottom, these pins aren't brought through the board. That means you have to remove these pins on the IC socket – it's not a good idea to start cutting pins on the IC's themselves.

Since IC sockets can be quite expensive (even more expensive than some of the IC's themselves), we suggest a product called Molex Soldercon IC terminals, or just

MOLEX pins. These are individual little clips, one for each IC pin, which come in long strips joined by a connecting strip. You break off as many as you need (such as a strip of 7 for one side of a 14-pin IC), insert the whole strip into the board and solder, and then snap off the connecting strip. This leaves seven independent little clips, standing up from the board. Put another seven on the other side of the lineup, and you have fourteen clips, ready to plug in the IC itself. It's essentially the same as a regular socket, but without the plastic to hold it all together. The big advantage is cost – at about 1¢ a pin, you have a 14-pin socket for 14¢, instead of the 50¢ or more for a regular socket. There's another good reason as well – with a regular socket it sometimes happens that one of the pins doesn't make it through the board. Unless you notice it before you solder, it's an awful job to fix up the mess later.

But back to Fig. 20. The way the input jack is shown, an input signal at the jack is fed to switch Sla, and then to either the low-frequency circuit or the VHF scaler, depending on the position of the switch. S1



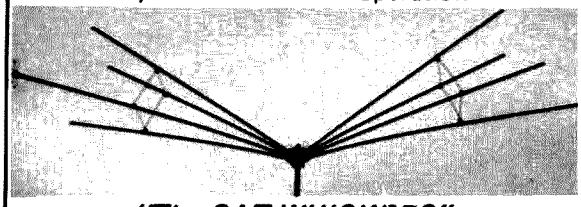
Above sketch shows location of circuit on main circuit board.

*Fig. 20. 0–20 MHz (low frequency) input circuit. Notes: 1. See Fig. 3 for diagram; 2. Capacitors marked * are bypass capacitors not shown on diagram. 3. Omit S1 if no VHF scaler installed.*

is actually a DPDT switch, with the other pole shown in Fig. 22. If you want to simplify the switching, you might eliminate the part of S1 shown in Fig. 20 and use two separate input jacks instead. This might have

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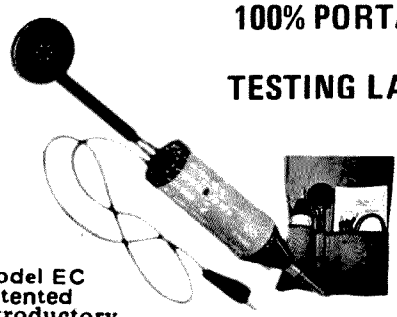
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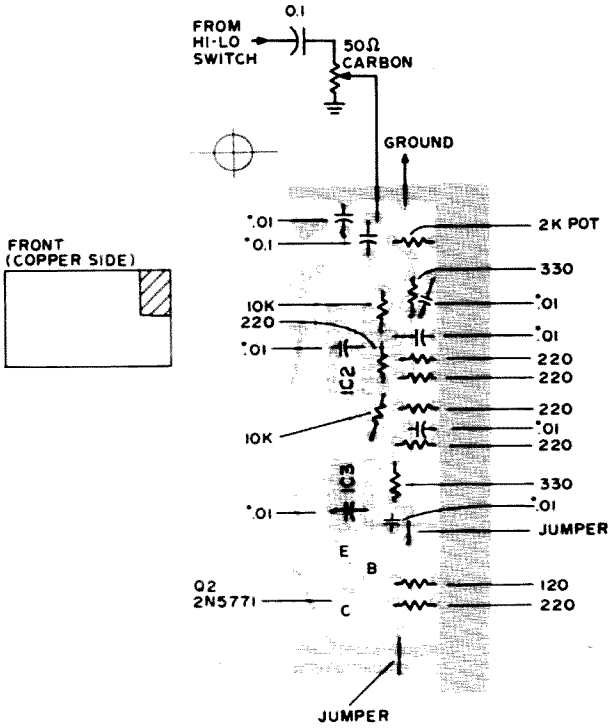


*Fig. 21. VHF prescaler circuit. Notes: See Fig. 4 for diagram; 2. Note the two 0.1 disk capacitors between pins 5 and 12 of IC; 3. Capacitors marked * are bypass capacitors not shown on schematics.*

the advantage of allowing you to hook up the counter to two different places, and measure the frequency at either by just flipping S1.

Figure 21 shows the VHF scaler circuit. If you are not including the scaler in your counter, then simply omit all parts in this figure, and omit S1 as well, wiring up the input jack directly to the low-frequency input circuit instead. Otherwise, the VHF scaler is pretty much standard. Make sure,

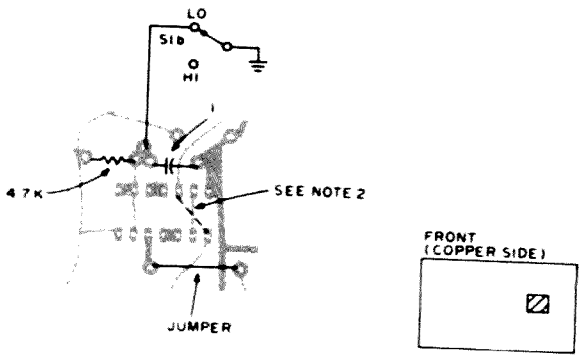


Fig. 22. Input selector circuit. Notes: 1. See Fig. 5 for diagram; 2. If no VHF scaler is used, this circuit is not needed. Omit all parts shown and jumper pins 5 and 8 as shown by dashed line.

here as elsewhere, to place all parts right down against the board with the shortest leads possible. Notice also the two small 0.01 μF capacitors mounted underneath the two IC's. After you solder in the IC sockets (they go on top of the board), solder the two capacitors on the bottom of the board to the two pins shown (pins 5 and 12), using the shortest leads you can. The capacitors should be bent down tight against the underside of the board.

Figure 22 shows the input selector, needed only if the VHF scaler is installed. If not used, just omit all the parts shown and jumper pins 5 and 8 on the IC pads.

Figure 23 shows the major part of the board, containing the counters, latches, decoders, and over-range circuits. This part of the board will keep you busy for a while, since it has 37 wire jumpers. Make sure that these jumpers are as short as possible, flat against the board.

Shown at the left of Fig. 23 is all the circuitry for the over-range indicator and the power supply for the Numitron or Minitron readouts. As pointed out last month, we need a separate supply for these incandescent readouts, but not for LED readouts. Hence if you decide to use LEDs, you can omit the transformer and the two diodes. You can also omit Q3 and 10K resistor, since the LED over-range indicator can be driven directly off the output of IC21, pin 13, as shown in Fig. 28. Incidentally, if you are using LEDs, you can also omit the four jumpers at the very front of the board, connecting pin 2 of all the Numitron sockets, but don't forget the ground to terminal LG, which connects to the system ground all the way back at the +5V power supply.

Figure 24 shows the 10 MHz crystal oscillator and the time base dividers. Only two comments here. Note the short jumper runnning under IC24 and IC28. Put this jumper in before putting in the IC sockets, to make the work easier for yourself. Second, when putting in the 10 MHz crystal, leave the leads on it about 1/2" long. As pointed out in the first part of the article, someday you may want to place the crystal in an oven, and at that time you'll appreciate this.

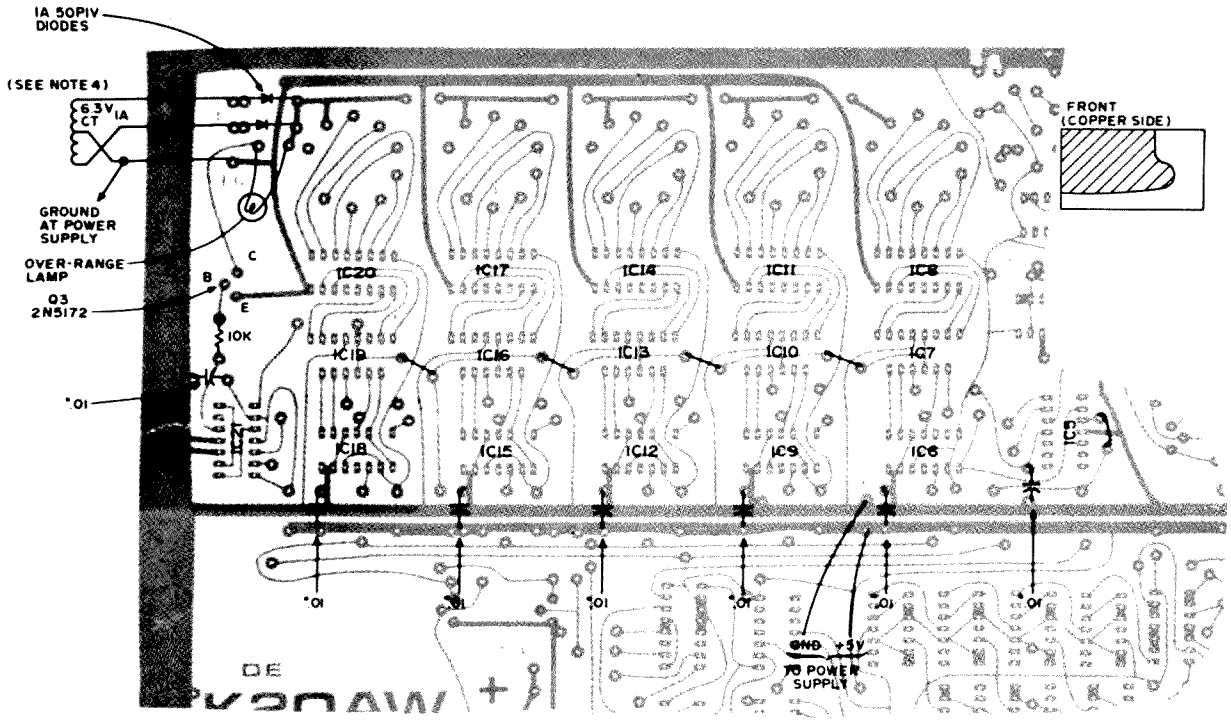


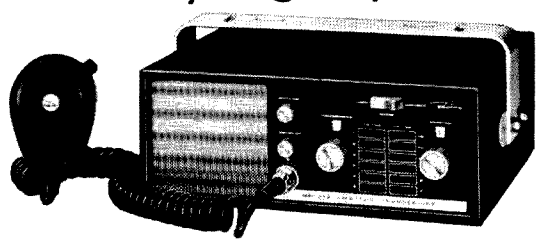
*Fig. 23. Counters, latches, decoders and over-range circuitry. Notes: 1. See Fig. 6 for diagram; 2. There are 37 jumpers shown — don't miss any; 3. Capacitors marked * are bypass capacitors not shown on diagrams; 4. Q3, transformer, diodes and associated parts not needed for LED readout.*

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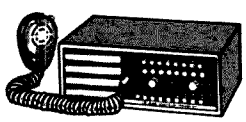
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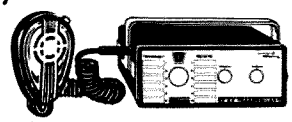


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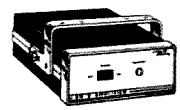
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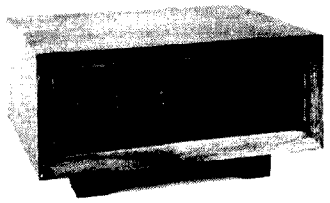
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Figure 25 shows the time base selector and control circuits. Note again two jumpers running under IC sockets, as before. Make sure that the switch is connected as shown. The lead to the switch can be a single unshielded lead, running either under or over the board, up to the front panel. Virtually any silicon NPN transistors can be used for Q3, Q4, and Q5 as long as they have reasonably good gain, but we suggested the 2N5172 since it is very cheap.

Figure 26 shows the +25V supply, mounted in a corner of the main board. As shown, the circuit is designed for a 38V center-tapped transformer, and uses a full-wave rectifier. If you have a 16- to 20V transformer, add two diodes as shown and eliminate the centertap. This makes the circuit a full-wave bridge. Watch the polarity on the electrolytic, and use a 50V unit, not a 25V unit!

As part of the +25V supply, you will need a long jumper from the 25V terminal over to the 4.7K resistor near Q1, shown at the left of Fig. 20.

As mentioned earlier, the easiest readout to use is the Numitron; just install 9-pin miniature tube sockets on the board and plug in the readouts. In one of our prototypes, however, we used LEDs because of their good looks. Figure 27 shows the LED readout board for mounting them. In addition to MOLEX pins or 14-pin IC sockets, you will need 35 150Ω resistors for current limiting. The over-range indicator also

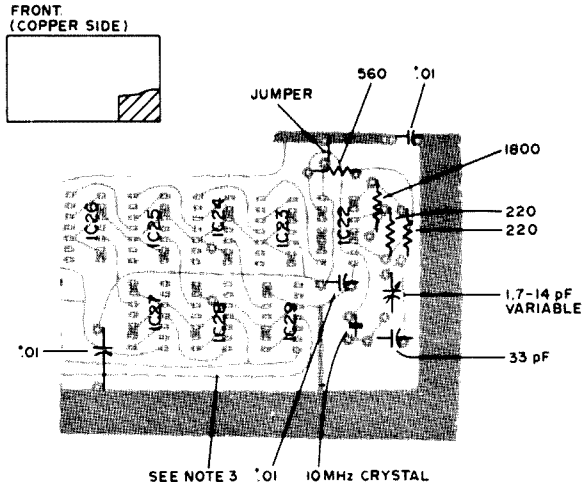


*Fig. 24. 10 MHz crystal oscillator and time chain divider circuits. Notes: 1. See Figures 7 and 8 for diagram; 2. Capacitors marked * are bypass capacitors not shown on diagram; 3. Note the jumper running under IC24 and IC 28.*

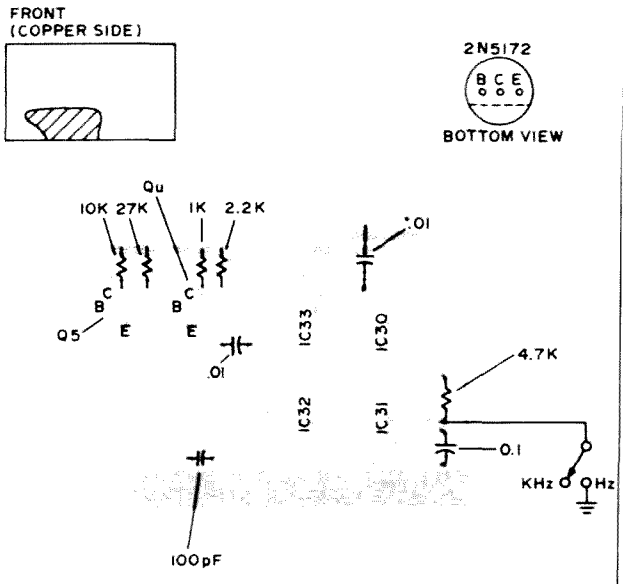


*Fig. 25. Time base selector and control circuits. Notes: 1. See figures 9 and 10 for diagram; 2. There are 11 jumpers shown — note especially the jumper running under IC32 and IC33; 3. Capacitor marked * is a bypass capacitor and is not shown on diagrams.*

mounts on this board; the board has room for two over-range indicators, one above the other, to make a sort of : (colon) arrangement, but only one is really needed. For LED over-range indicators you will also need 220Ω current limiting resistors. If you decide to use incandescent over-range bulbs, then follow the hookup as shown in Fig. 23, but you will need a spearate source of lamp voltage. It seems to be the hard way.

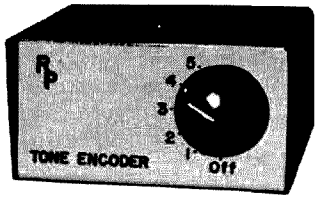
To connect the LED board to the main board, note the letters cgdaebf on the LED board, on one of the 9-pin sockets on the main board, and in Fig. 15. The actual connections are shown, for one LED indicator, on Fig. 28. The cgdaebf terminals for each LED connect to the like terminals on the main board, to the corresponding 9-pin socket. The over-range LED connects to pin 13 of IC21, through the 220Ω resistor, the 5V terminal on the LED board goes to +5V at the power supply, and the LG terminal goes to the ground terminal, also at the power supply. If you use two LEDs for over-range we suggest using Q3 and the 10K resistor, and connecting the 120Ω resistors to Q3 at point X, as shown.

After wiring up the main board, but before installing the IC's in their sockets, we suggest that you examine the board carefully

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for good solder joints and no shorts. Hopefully you used a small pencil iron, such as a 30-watt Ungar, and good solder. We like 60% tin, 40% lead (not the other way around!) solder of the thin variety. If you scrub the board with Brillo soap pads just before starting construction, to clean off the copper, you should have no trouble soldering to it with a minimum of heat and solder.

Once construction is done, check for shorts. Use an ohm-meter to check between ground and the +5V connection point shown in Fig. 23. With all the IC's out, you should get a high reading – at least several hundred ohms.

Now is also the time to build the power supply. After you finish it, make sure to test it and, if needed, adjust the output voltage to +5V before connecting to the main board. An over-voltage can ruin a lot of expensive IC's

Once everything is hooked up, take the big step and turn on the main power. If all the indicators read 00000 you will probably breathe a sigh of relief, but all is not done yet. With luck, your counter should now be working. Except for two bad connections, our second prototype worked right away. Just in case that your counter doesn't work and you need to do some troubleshooting, here is a suggested way of going about it. You will probably need a scope, though.

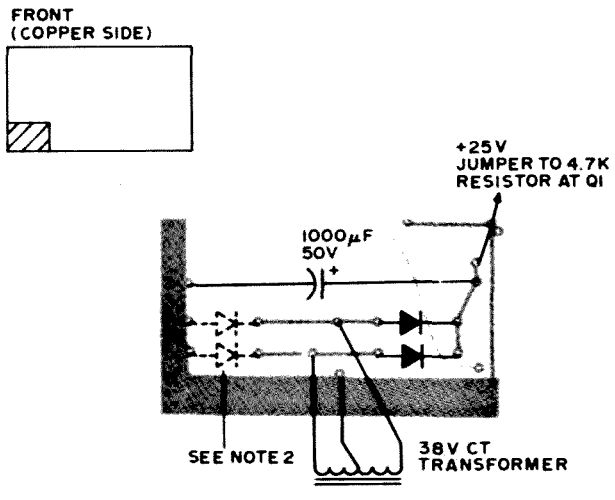


Fig. 26. +25 volt power supply. Notes: 1. Circuit shown in diagram in Fig. 17; 2. Supply is designed for a 38V CT transformer – if a 16–20 v transformer is used, disconnect centertap and add two diodes as shown dotted, thus converting the rectifier into a bridge.

First, check the 10 MHz oscillator and time chain dividers. Put a meter (20,000Ω per volt VOM) at IC23 pin 11. The meter should swing up and down at the rate of one cycle per second. If so, fine. If not, use a scope to trace the signals through the circuit. Check the points in Table I for the signals shown.

TABLE I

Signal	IC	Pin
10 MHz	22	8
1 MHz	23	11
100 kHz	24	11
10 kHz	25	11
1 kHz	26	11
100 Hz	27	11
10 Hz	28	11
1 Hz	29	11

If no 10 MHz signal appears at IC22, interchange the SN7400N IC with one of the others in the counter. If the signal seems to go down the line but stops at some point in the divider chain, interchange the affected SN7490N with another. In this way, you should be able to get the oscillator and divider chain working.

Next step, if everything is OK so far, is to check whether the indicators light. If not, check the power connections to the indicators, and the ground and +5V connections to the SN7447N decoder/drivers. If some indicators light and others don't, interchange IC's and indicators (with the power off!) to try to narrow down the cause. If interchanging the IC's doesn't do it, check your connections.

Once the indicators light, they will probably read all zeroes. Place the Hz–kHz switch in the Hz position and turn off the power for about five seconds. When you turn the power back on, the indicators should come back with some really crazy readings, or perhaps even totally dark. It should take about two seconds for them to reset back to zero. This is because the flip-flops in the counters and latches come back in random states, and it normally takes two seconds to get everything reset back to zero. If this occurs as described, fine. Otherwise check the control circuits for wave-

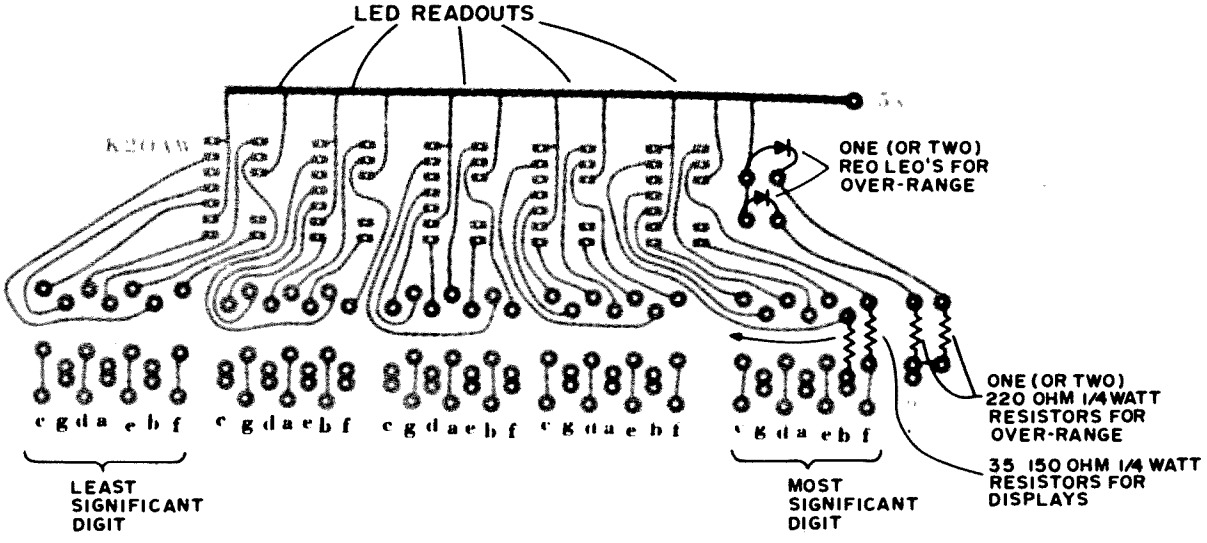


Fig. 27. Rear view (copper side) of board for mounting MAN-1, 10A, or LED-700 readouts.

forms similar to those in Figs. 11 and 12, depending on the position of the Hz–kHz switch. Unless you have a really good scope, you may not be able to see the thin pulses on the reset and strobe lines.

Once everything seems to work OK, remove IC4, and connect a short wire to pin 8 of the socket. Place the Hz–kHz switch in the kHz position, and use the wire to trace the signals listed in Table I, starting at 1 kHz and going up in frequency. The 1 kHz signal should result in a reading of 00001 on the displays, the 10 kHz should result in 00010, and so on. Go through all five counters like this, checking for a 1 in each place. If everything works fine at lower frequencies, but not at the higher frequencies, check the SN7490N counter at the right most position that doesn't work by interchanging it with another to its right – don't go back and swap IC's in the time chain dividers, though – leave well enough alone. If most of the readings here are OK but one of the digits in the center does not seem to work, check the counter, latch, and decoder as well. If you use any readout other than the Numitron, and get some strange readings, check the wiring between the readouts and the main board for a mixup.

Once you have gone this far, you are pretty close to being home. Try both input circuits. If one input works and the other doesn't, that should narrow down the trouble. If neither works, check the circuitry around IC4. Check also the wiring to S1 – you may have the wiring mixed up so that the input of one of the two input circuits is connected at the same time as the output of the other. You won't get too many signals through that way.

Once everything is working, readjust the 2K and 5K pots for best sensitivity. Don't be

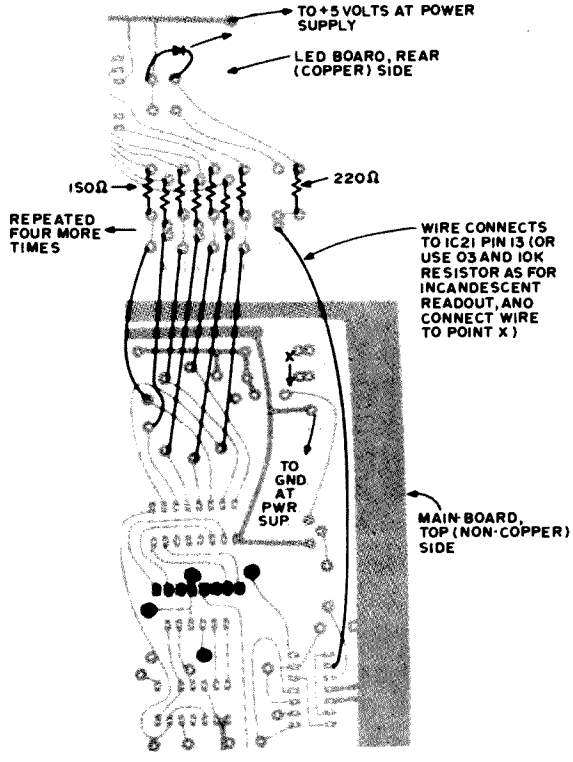
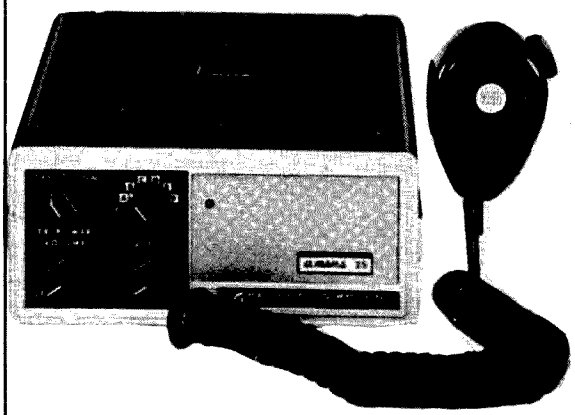


Fig. 28. Connections between LED board and main p.c. board.

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surprised if the VHF input shows some reading even with no input connected. This indicates some oscillation in the input amplifier, and you can easily eliminate it by slightly moving the setting of the 2K pot. We've seen even some fairly expensive commercial counters do this, and the oscillation usually gets swamped out when an actual signal is connected.

The inputs are actually quite sensitive. We have a local radio station on 1310 kHz a mile or so away, and we often notice the counter with a 01310 indication when connected into a circuit which has its power turned off. If you forget to connect the ground to the input of the counter, you may often see a 00060 reading in the Hz position – that's just plain hum. It's nice to know that your local electric company keeps its frequency on the nose.

Speaking of frequency, there is one more adjustment to be done, and that is zeroing of the 10 MHz oscillator against WWV. This is quite simple, as the counter puts out a nice 10 MHz signal with the case off. If you find that the crystal won't quite go to 10 MHz, you can change the value of the 33 pF capacitor in parallel with the trimmer capacitor as needed. If you can't receive WWV, then you might connect another (calibrated!) counter to the 10 MHz signal and adjust that for the right frequency. Heathkit has another trick in their instruction manual for their counter, and that is that you place an ordinary transistor AM radio near the counter, and tune to a broadcast station. Since the counter puts out strong signals at 10 and 20 kHz as well, the harmonics of these will beat with the station. Since the FCC requires commercial stations to be close to their assigned frequency, which is always on a multiple of 10 kHz, you can zero beat the counter against the station. But pick a station which you know to have a good engineering staff, not your local college run station run by sleepy-eyed undergraduates.

And don't let your friendly envious hams talk you into calibrating your counter with a borrowed BC-221 frequency meter! Try a little one-upmanship and offer to them first.

I'd like to thank Mike, WB2AAQ, for his help in building one of our prototypes.

. . .K2OAW

Peter A. Stark K2OAW
196 Forest Drive
Mt. Kisco NY 10549

FREQUENCY SYNTHESIZER FOR 2M FM: Part I

One of the major expenses in going on 2-meter FM is the price of crystals. Even so, it seems you never quite have the right ones. Well, here's the device to eliminate all that – a frequency synthesizer which lets you hop all over the band.

The complete information to enable you to build your own will be presented in three parts. This month we will give a complete description of what the synthesizer is and what it can do, along with a block diagram and simple description of how it works. If you decide to go ahead with building it, there's a complete parts list at the end of this installment. Next month we give the diagrams and the detailed theory of operation. The month after that we will have the printed circuit board layout, parts layout drawings, and construction and operating information.

And now a little information about the unit:

1. The complete price should be under $100, depending on where you get your parts. We will have some information on parts sources in the parts list later.

2. The unit covers from 145 to 148 MHz in steps of 5 kHz. With a few modifications the range could be extended down to 144 MHz, but that complicates the switching and so we decided against it.

3. It is inherently quite stable. It has only one crystal, at 10 MHz. Once you beat this crystal against WWV all other frequencies automatically fall in line.

4. The synthesizer can be used for both transmitting and receiving, with a choice of two-frequency operation. That's a necessary feature for working through repeaters, since you can transmit on one frequency and receive on another.

5. It is designed as a crystal substitute. You merely plug the synthesizer output cables into the crystal sockets of your rig. It is not a complete transceiver by itself.

6. It is designed to operate with most common amateur two-meter transceivers. The unit could also be used with most commercial transmitters of the GE/Motorola class, but you'd have to make some changes to use it for reception as well. The synthesizer is designed for receivers having either 10.7 or 11.7 MHz i-f frequencies with low-side first oscillator injection, which pretty well limits it to use with the more popular amateur-only transceivers.

7. Since the synthesizer is only a crystal substitute, your regular transceiver is used for all other functions (such as modulation). But in case you have an AM rig, it is possible to FM modulate the synthesizer itself. That will give you an FM signal. In our prototype

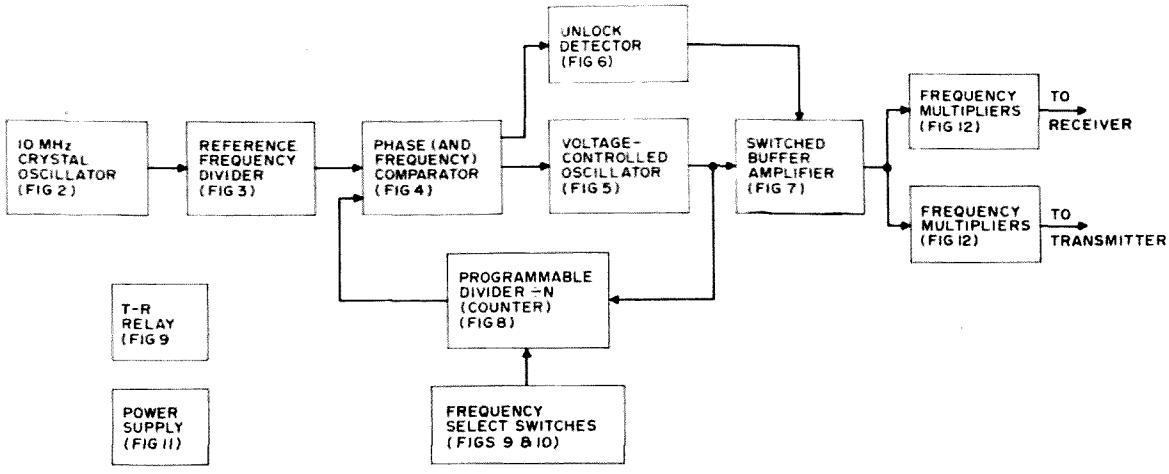


Fig. 1. Frequency Synthesizer

we had a little extra room in the case, and so we decided to install a touch-tone pad, which modulates the synthesizer. We plan to put in a tone-burst encoder and PL (snythesized?) at a later time.

8. We went out of our way to make the project easy to build. Except for the power supply, switching, and output buffers and multipliers, everything else fits onto a 7" x 9" printed circuit board. The p.c. board layout and etched boards are available to make your job even easier.

The requirement that the synthesizer work with a variety of transceivers makes the design a bit awkward, since different transceivers use different crystal frequencies. You can ignore the circuit capacity that your unit is designed for, since that has no effect on the output frequency with the synthesizer, but the crystal frequency itself (and the equation used to calculate it) is an important factor. Table I lists the requirements for several common amateur transceivers. As you can see, the actual crystal frequencies range from 6 MHz to 45 MHz. Most of the rigs use a 10.7 MHz receive offset, except that the Standard uses 11.7 MHz; this requires a small change to the synthesizer. (The new Swan FM 1210-A uses 16.9 MHz offset. You'd have to make a number of changes to adapt the synthesizer to that rig.)

As you can see in Table 1, most of the transmit crystals are 8, 12, or 18 MHz (the older Regency HR-2 uses 6 MHz rocks). We decided to build our unit to output at 6 MHz, which can easily be doubled to 12 or tripled to 18 MHz. If you need 8 MHz, then you will have to change the design a little to output at 8 MHz directly. It is also possible to modify the synthesizer to output directly at 12 MHz, but it's easier to take the 6 MHz output and double it.

As for receiving, most rigs use 45 MHz rocks. You can start with 6 MHz and multiply by 8, start with 8 MHz and multiply by 6, or start with 12 MHz and multiply by 4. The 15 MHz signal needed by the Standard can be obtained from 8 MHz by doubling. But keep in mind that if you plan to use the synthesizer for both receive and transmit you have to pick a common frequency output. You can't pick 6 MHz output if you need 15 MHz for the receiver, since you can't double or triple 6 to get 15. Since 6 MHz seems to be the most useful with the widest variety of units (including our Varitronics IC-2F and an old Pre-Prog transmitter) we decided to design for that.

TABLE I

Crystal Frequencies for Common Transceivers

Unit	Transmit Formula	Transmit Freq.	Receive Formula	Receive Freq.	Synthesizer Output
Varitronics IC-2F	$\frac{f}{8}$	18 MHz	$\frac{f-10.7}{3}$	45 MHz	6 or 12 MHz
Varitronics IC-2F	$\frac{f}{8}$	18 MHz	$\frac{f-10.7}{3}$	45 MHz	6 or 12 MHz
Drake	$\frac{f}{12}$	12	$\frac{f-10.7}{3}$	45	6 or 12
Standard SRC-826M SRC-146	$\frac{f}{18}$	8	$\frac{f-11.7}{9}$	15	8
Swan FM-2X	$\frac{f}{12}$	12	$\frac{f-10.7}{3}$	45	6 or 12

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RECEIVER: • Completely transistorized, crystal-controlled superhet • Intermed. Freq: 1st 10.7 MHz, 2nd 455 kHz • Input Imped: 50 to 75 ohms • Sensitivity: 0.5μV or less/20 dB quieting; 1μV or less/30 dB S+N/N at 10 kHz dev., 1 kHz mod. • Audio Output, 0.5 W • Spurious Sens., > -60 dB.

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The rest of this article describes the 6 MHz version, but wherever applicable we will tell you the applicable information for the 8 or 12 MHz versions. If so, the additional information will always be in parentheses, following the 6 MHz information.

And now on to details. Figure 1 shows the block diagram of the overall unit. The individual diagrams for each block will be shown next month, and the block diagram gives the figure numbers for each detailed diagram.

The heart of the unit is the voltage-controlled-oscillator which we will simply call the VCO from now on. The VCO actually generates the 6 MHz (or 8 or 12 MHz) output frequency. This signal is fed into a switched buffer amplifier and then into the frequency multipliers needed to generate the correct crystal frequencies for your rig. Two sets of multipliers are usually needed, one set for the transmit frequencies and one for the receive frequencies.

All the rest of the synthesizer is used as an automatic frequency control to keep the VCO on frequency. The correct terminology is actually to call it a phase-locked-loop (PLL). This is done by a feedback loop which compares the VCO output frequency with a crystal-generated reference frequency in the phase (and frequency) comparator. It is used here as a frequency comparator, but since it works by actually comparing phases it is called a phase comparator.

Since the crystal frequency and the VCO output frequency are not the same, we can't really compare them directly. Instead, we take the 10 MHz crystal frequency and divide it by a factor of exactly 48,000 in the reference frequency divider to get 208-1/3 Hz (in the 8 MHz version we divide by 36,000 to get 277-7/9 Hz, and in the 12 MHz version we divide it by 24,000 to get 416-2/3 Hz).

At the same time, we take the VCO output frequency and divide it by another number, N. But this division is done in a programmable divider, and the exact number by which we can divide is changed by the

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frequency Select Switches. Suppose we want an output on 145.000 MHz. Then the switches are wired in such a way that the progrmmable divider divides by exactly 29,000. Then the divider takes the VCO output frequency, divides it by 29,000, and sends the result to the phase comparator.

The phase comparator looks at the two frequencies it gets. If they are exactly the same, nothing happens. But if the frequency coming out of the programmable divider is too low, the phase comparator decides that the VCO frequency is too low also, and sends a control signal to the VCO to increase its output frequency. In the same, way, if the frequency fed back from the programmable divider is too high, the phase comparator forces the VCO frequency down. In this way the phase comparator controls the VCO in such a way to make the output from the programmable divider the same frequency as the output from the reference frequency divider. This is the automatic frequency control action.

Now, if the output of the VCO, divided by the number N, is equal to the reference frequency, another way to look at it is that the output of the VCO is the reference frequency times N.

Using the 6 MHz synthesizer as an example, if we set the switches for 145.000 MHz output (so that N is 29,000), then the output from the synthesizer is the reference frequency (208-1/3) times N (29,000). If you multiply this out, you get exactly 6.041667 MHz. This is the exact 6 MHz crystal you would need to multiply up to 145.000 MHz. (If you want to do a little work, you can multiply 29,000 by the reference frequencies used in the 8 or 12 MHz synthesizer, to check that you get the right output frequency.)

Since the phase-locked-loop forces the VCO output frequency to equal the reference frequency times N, the way we get various output frequencies to cover the range from 145 to 148 MHz is to change N. This is done with eight front panel frequency selection switches. Just as an example, at several typical frequencies we have the following:

PARTS LIST

4	SN7400N	2	100K	(Calectro D1-893 or equiv) (Coil
3	SN749ON	14	330	is 3-6 μHy, adj.)
1	SN7492N	1	7"x9"	1.7-14.1 pF air variable capacitor
1	SN7492N	300		(Johnson 189-505-5)
1	SN7493N	1-4	PAX-1	NPO disk capacitors
4	SN74192N	1-4	33K	disk capacitor
1	SN7473N		TTL Quad two-input *nand* gates	disk capacitor
1	SN7474N		TTL decade counters	disk capacitor
2	SN7404N		TTL Divide by 12 counter	disk capacitor
1	SN743ON		TTL Divide by 12 (8 MHz output	15Vdc electrolytic
2	SN741ON		only)	15 Vdc electrolytic
1	LM309		TTL programmable up-down de-	15 Vdc electrolytic
1	LM309K		cade counters	15 Vdc electrolytic
1	MC1648P		TTL dual J-K flip-flop	15 Vdc electrolytic
1	40673		TTL Type D flip-flop	15 Vdc electrolytic
1	MFE3002		TTL hex inverters	1W resistor 10%
6	2N706		TTL eight-input *nand* gate	1/2W resistor 10%
1	2N5771		TTL triple 3-input *nand* gate	1/4W resistor
1	HEP52		5V regulator, 250 mA. (may be	"
1	2N3055		replaced by an LM309K if you	"
1			mount it off the board)	"
7	1N4001		5V regulator, 1 amp., plus finned	"
23	1N914		heatsink	"
1			MECL oscillator	"
1			RCA dual-gate-protected FET	"
2			transistor	"
2			Motorola enhancemnt N-channel	"
4			FET transistor (caution – don't	"
2			remove clip on wires.)	"
1			NPN fast switching transistors, or	"
1			equiv. (sil.)	"
1			PNP fast switching transistor, or	"
2	33 pF		equiv. (sil.)	p.c. board
1	.001		PNP transistor or equiv. (sil.)	MOLEX Soldercon pins, used for
1	0.1		(or TIP3055) NPN silicon power	IC sockets
18	0.01		transistor (or equiv.)	International Crystal power
2	100 pF		12-volt 10-watt zener diode	amplifiers, one for each doubler
1	2000 μF		silicon diodes (1 amp, 50 PIV)	or tripler
1	1 μF		(Do not substitute for the two	1/2 resistors, one for each PAX-1
3	250 μF		paralleled ones in the VCO unless	used
2	100 μF		you know what you are doing.)	
3	30 μF		silicon switching diodes (or	Miscellaneous
1	10 μF		equiv.)	Chassis, case, power switch, con-
1	47Ω		LED indicator diode – red	nectors, coax, #32 enamel wire
1	60Ω		(LOCK light) (optional)	for coil, knobs, power supply
4	220Ω		12VDC 10 mA SPDT relay	providing 12V at 750 mA (or
1	1800		(Sigma 65F1A-12dc or Calectro	auto or motorcycle bat-
1	560		D1-967)	tery) – must be well filtered.
4	1K		SPDT toggle switches (CHANNEL	
1	1 meg		SELECT)	
1	12K		SP3T rotary switches (MHz SE-	Notes
1	27K		LECT)	Printed circuit board layouts are
3	10K		3P10T rotary switches (100 kHz	available from the author (send
1	1.5K		and 10 kHz)	SASE); etched boards and parts
2	4.7K		SPDT rotary switches (0-5 kHz)	kits are available from Circuit
2	2.2K		AT-cut 10 MHz series-resonant	Specialists, Box 3047, Scottsdale,
1	15K		HC-18/U crystal coil form, 7/32"	Arizona, 85257. Contact them
1	470		dia., 15/32" long, ferrite slug	directly for information.

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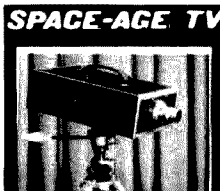
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1301 N. BROADWAY **ATV Research** DAKOTA CITY, NEBR. 68731

at 145.000 MHz, N is 29,000
at 145.005 MHz, N is 29,001
at 145.010 MHz, N is 29,002
at 146.940 MHz, N is 29,388
at 147.995 MHz, N is 29,599.

As you can see, changing N by 1 changes the output frequency by exactly 5 KHz, thus giving us the 5 KHz channel spacing. If we make the programmable divider adjustable so N goes from 29,000 to 29,599, that will cover the entire 3 MHz of the band.

Since each count in the programmable divider changes the output by 5 KHz, if we subtract 2140 from N during receiving we will automatically drop the output by 10.7 MHz. (To use an 11.7 MHz receive i-f offset, we subtract 2340.) This subtraction is done automatically by a T R relay. In fact, the switches can be wired to indicate the actual channel frequency. It is not necessary to figure out the value of N corresponding to the operating frequency – if you want to transmit on 146.340, just set the four transmit switches to the digits 6340. To receive on 147.015, just set the four receive switches to 7015. It's that simple.

When you use the synthesizer for transceiving, the VCO has to switch back and forth between two frequencies every time you push or release the mike button. As with any feedback system, this takes a little time. In the synthesizer, it takes the VCO about ¼ to ½ second to reach and settle on the new frequency. To make sure that you don't transmit on the wrong frequency during this interval, an unlock detector monitors the phase detector output, and turns off the switched buffer amplifier while the VCO is moving to the new frequency. This makes it a little rough to break into conversations, but we've researched the problem and, short of having separate synthesizers for receive and transmit, there seems to be no way of getting around the problem. We could reduce this time below ¼ second, but only by greatly complicating the unit and upping the cost.

Next month we will continue with more info.

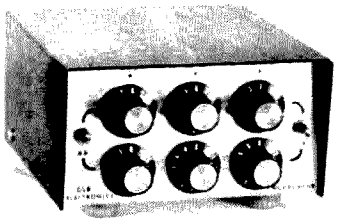
. . .K2OAW

(Continued from page 9)
a hold and the speaker wires are right there ready.

The power cord comes with a jack built into it – handy for taking the rig out for changing crystals or using it in the house. You can use one crystal for two or more channels if you are a cheapskate too, with a simple cross wire which you can install in seconds – or take out. This is nice for things like 34–94 and 94–94 pairs.

With all the features one might expect this unit to sell for well over $300 – so it will probably boggle a lot of minds to find that this power house sells for only $249.95. It's the most powerful rig you can buy today unless you get an outboard amplifier. *General Avaiation Electronics, Inc., 4141 Kingman Dr., Indianapolis IN 46226.*

GLB SYNTHESIZER



The GLB Electronics model 400B synthesizer is now beginning to become available to dedicated FMers. This synthesizer is designed to work with most of the popular ham FM transceivers and make them so they can hit any 10 kHz frequency on transmit and receive in the entire two meter band, from 144–148 MHz.

There are two sets of dials for setting the frequencies. One set is used for transmitting channels and the other for receive . . . plus there are switches to reverse this order if you happen to feel like it. Or you can use one set to transceive, if that turns you on.

Once you have plugged the 400B into your transceiver and programmed its output to match your rig's crystal requirements, all you have to do is switch from any channel to any other at will. If you want to use a 31–91 repeater you switch the transmitter dials to 6–3–1 and the receiver dials to 6–9–1. It is that simple! Perhaps you want to check the reverse pair? One flip of the two toggle switches and you are listening on 31 and transmitting on 91. That's handy at times.

The specifications that come with the unit have a lot of details that might interest you, though they have little to do with the use of the unit. Like it uses 350 mA at 10–15V dc . . . takes about 10 milliseconds to lock up between receive and transmit . . . uses the push-to-talk from the transceiver . . . has a frequency stability of .005% . . . size 3" high, 5¾" wide, 6½" deep . . . has enough power to feed even fairly long cables, etc.

The model 400B sells for $130 in kit form and $190 assembled. More info can be had from *GLB Electronics, 404 Cayuga Creek Rd., South Cheektowaga NY 14227.*

The GLB part of the company name comes from Gil Boelke W2EUP and the project is an outgrowth of a group effort by the Buffalo repeater association. Gil has sneakily removed the IC numbers and substituted color codes on the eleven ICs in the unit, so don't expect that you can borrow a unit and make one up for yourself. I don't see much in the way of identification of the 14 or so transistors either.

While it is not quite as fast to work the two sets of switches as it is one channel switch, the total flexibility of the arrangement certainly makes up for the slight additional work. Every repeater is immediately within your reach – every simplex channel – every invert pair – no matter where you go. If you get into a new area you know you can still match anything they can dream up in weird pairs. . .even in Chicago and Los Angeles! – and that's saying a lot.

STANDARD SRC-826M UPDATED

Standard doesn't seem to even try to take advantage of their changes in design. Pity, for they have been making substantial improvements in the unit and the changes should be brought to the attention of the prospective customers.

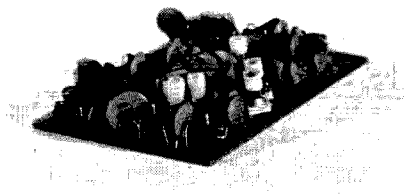
The recent review of the 826 in *CQ* was particularly unfair, with a good deal of space being taken up airing complaints over problems that have been surmounted for quite a long time. The fact is that the Standard equipment that has been sold for the last couple of years has been of excellent quality.

The current model 826 has been changed so that the crystals are right out there in the open when you open a little door in the cabinet. You don't even have to take the rig out of the case to change or tweak crystals now.

Sometime in the last year the 826 crystal deck was changed from its previous vertical position to horizontal. This was a major improvement since it made it infinitely simpler to get in there and tweak those trimmer capacitors. The older model required the services of a malformed dwarf to get into the trimmers – the horizontal board cured all that, putting the capacitors where anyone could reach them. The new door just makes it even easier.

Standard is a bit evasive about the i-f filters they are using, but there is good reason to believe that they have been sending their units along with ever narrower filters. The 826 may have the narrowest i-f on the market today. This makes a big difference when the set is to be used in a major city where the rf pollution is high and where there may even be a 146 MHz repeater output within 30 kHz of the desired channel. Many sets fall apart under these conditions. In situations such as this the reason for paying a bit extra for a transceiver becomes very apparent. *Standard Communications, 639 N. Marine Ave., Wilmington CA 90744.*

2mFM FOR $35.00



As impossible as it seems, there is now a neat little two meter FM transmitter on the market for only $35 – and that is complete with crystal and microphone. We found it difficult to believe at 73 when we received the first announcement of this rig, so we sent for a few of the transmitters, just to see. Sure enough, they arrived, complete with crystals and microphones, ready to go for the frequencies we had specified.

The rig has ten transistors and is built on a pc board only 2½" x 3" – the whole thing is about 3/4" thick, so it could easily be squeezed into a hand unit . . . or into just about any 2m receiver to make it into a transceiver. It uses an 8 MHz crystal (the crystals for the Standard transceivers will work just fine in it if you want to use more than the crystal that comes with it) and has three triplers, a buffer and power amplifier. The final runs about 0.1 watts with 8 volts on the unit and will go up to a full watt if you run the voltage up to 12 volts – and add some heat sinking to that output transistor. But why run high power when low will do the job, right? The 100 mW seems adequate for most line-of-sight applications.

It took about five minutes to solder some wire leads to the board for the 8 volt power (transistor 9V battery), a 19" "antenna" to the output terminal, and hook in the mike. The rig took off immediately and put out a beautiful signal. Tests were made through nearby repeaters – good reports. A couple of days later, Bill, W1PFA, had one of the little rigs working through the K1MNS repeater.

One of the first "conversions" on my units was to remove the soldered-

in crystal and put in pin sockets so regular FM crystals could be plugged in to change the frequency. That took about five minutes. Next I wired in a little transformer to step down the audio input impedance so I could feed the rig from a receiver and make a midget repeater out of it. For a few days I drove every passing amateur crazy with my tiny 34–94 repeater. It covered Peterborough nicely, which was what I had in mind. That little rig could do a fine job as a low powered repeater if I put it up on the mountain. I note that the German repeater on the Zugspitz has only been running about two watts, and has been used over 200 mile paths.

Perhaps, with the era of these extremely low cost rigs, we may find one-town repeaters becoming popular – perhaps even mobile repeaters may be next.

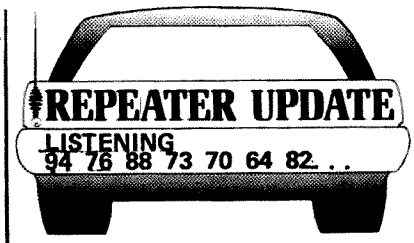
The amateur interested in simple construction could take this little rig and build it into a hand unit quite simply. He might add a little transistor radio and converter – or perhaps he might work on International Signal to release the receiver boards they make.

These boards are made in the U.S.A. by the same company that puts out the Clegg equipment. They were originally designed for being built into fire hats to provide communications for firemen. When that project was cancelled, International Signal found themselves sitting there with a few hundred midgit transmitters and receivers. Hmmm, they said, would the amateurs be interested in cleaning out these leftovers? They sent out a trial letter to a few hundred known FMers and the answer was a resounding YES! The rigs disappeared instantly. Hmmm,, they then thought – let's see what happens if we advertise them in 73.

At $35 this has to be one of the best bargains ever to hit for the FM amateur.

There has been some talk of using these inexpensive transmitters as another weapon in repeater wars. Imagine the consternation of the repeater mogul who has been crushing co-channel repeaters with high power when he finds that his repeater is being keyed up by short random pulses from well hidden things like this. It could take forever to find them. Such talk is irresponsible and such an approach to repeater problems should not even be considered. There is no King of Repeaters so arrogant that you cannot sit down face to face with him and work out your problems. Well, there may be one that arrogant – but only one, and he isn't *your* problem. No, let's be sure to use these almost throw-away priced transmitters for the benefit of amateur radio, not to further battles.

73 will welcome application ideas for these rigs – conversions – whatever. *International Signal, 3050 Hempland Road, Lancaster PA 17601.*



AL	WB4QCL	Montgomery	34 – 94
AL	W4MWF	Montgomery	16 – 76
AL	W4QEE	Mobile	22 – 82
CA	WA6ILA	Mt. Oso	28 – 88
CA	WA6RTM	San Miguel	518 – 670
CA	K@PHF	Pueblo	DELETE
GA	WB4WST	Atlanta	34 – 76
HI	KH6FOX	Waikiki	16 – 76
HI	KH6EOL	Waialva	20 – 80
IN	K9HDH	Elkhart	16 – 76
IA	WA9BBQ	Ottuma	34 – 94
KS	W@DKU	Wichita	46 – 94
KY	W4YWH	Covington	19 – 79
MO	W@OKB	Savannah	25 – 85
MO	WA@ZIK	Eldon	28 – 88
NJ	K2GCL	Waldwick	25 – 85
OR	K7KGV	Grants Pass	34 – 94
CT	WA1KGK	Bridgeport	DELETE
CT	W1FPT	Trumbull	34 – 94
CT	WA1KHA	Manchester	04 – 64
CT	WA1OXW	Fall River	28 88
	(Change from W1RGG)		

SOLID STATE REPEATER

Not a few repeater groups are fed up with the miseries of keeping tubes in their converted surplus type repeaters. And how many repeaters sit there and work, month in and month out without requiring almost constant attention? The availability at a very reasonable price of a trouble-free solid state repeater should be welcomed.

Standard Communications has put together a repeater package using the best commercial Standard boards which should be very popular. The unit operates from 12 volts, which means that in most installations there will be a power supply with a good sized storage battery across it – so in case of ac power loss the unit will be able to operate from the battery. The drain is low – about 400 mA on receive and 3 Amps on transmit.

The fellows at Standard have tried to put everything in the repeater that you will need . . . input for the identifier . . . adjustable time out timer . . . external speaker jack for testing . . . carrier delay timer for the squelch tail (or tale, if you like that better) . . . and a remote control jack. The repeater is designed for 19" rack mounting and is only 5¼" high and 9" deep. The output is ten watts – about right for the average repeater. Higher power is rarely needed except to meet the needs of the repeater owners ego and almost invariably leads to the alligator syndrome. If the temptation is just too much and you must have more power, the ten watt output will drive one of the amplifiers available from Tempo and others quite adequately. Tempo has an amplifier in the works designed for repeaters, built on a 19" panel.

There are local controls on the repeater to turn the receive on, the transmitter on, the squelch on, a volume control for the speaker, a repeat-duplex switch, monitor switch and a tone squelch switch.

The price? Under $600. Just barely. *Standard Communications, Box 325, Wilmington CA 90744.*

HOT GEAR

Saul A. Cohen, K4ACJ, reports the theft of a Swan Cygnet Model 270 transceiver S/N 313022 and a Collins MIC Model MMs S/N 4294. The equipment was stolen from his car in San Francisco on June 4.

Contact Saul A. Cohen, K4ACJ, 4524 Michigan Ave., Miami Beach FL 33140. (305) 531-9782.

Roger W. Coulson, WA1NVC, 31 Rosedale Road, Watertown MA 02172 reports the theft of his 11 channel HR2A, No. 04-07152.

List from Past Issues:

Mfr., Model, Ser. No.	Owner	Issue
Halli, SR46A, No.446100	WA1EMU	9/71
Reg., HR-2, No.04-03505	WA5BNM	11/71
Sonar, FM3601, No.1003	WB2ARM	11/71
Coll., 75A4, No.804	W@MGI	12/71
GE, Portable, No.1041218	K2AOQ	1/72
Coll., 75SE-B, No.15640	Col.St.U.	1/72
Coll, 21S3, No.12000	Col.St.U.	1/72
Coll., 516F1,No.1649	Col.St.U.	1/72
Simp. Mod-A, No.35457	W2PWG	1/72
SBE SB-33 No.103906	WA5JGU	2/72
Heath HW22A No.907-1835	W1BDX	2/72
Nat'l HR050 No.280019	WA5DQF	2/72
Halli., SR160 No.416000-108039	K9YVA	2/72
Drake TR3 No.3858	WA9EYL	2/72
Coll., KWM2A No 13815	ARRL HQ M. Godwin	2/72
Coll., 312B4 No.59920 Coll., 30L1 No. 40084 Coll. MPL No. 44507 Coll. MM1 (mob. mike)		
Misco minispkr.	Sgt. Hopkins Wilm. DE Police	2/72
Swan SW174 No. 416-5	W@AXT	2/72
Reg. HR2A No.04-05896	K4GBL	2/72
Heath SB102,No.132-128107	W.Singer Woodbridge VA 703,491-2257	3/72
Yaesu FT-101 No. 107036	WA2YSW	4/72
Standard 2m FM No. 102703	W6NPV	4/72
Drake ML2 No. 20189	WB2LLR	4/72
Standard SRC-806M No. 009210	K1TLP	5/72
Aerotone 6M 355LT, No. 685064	RR Police Grd.Ctrl.Trml. NYC	5/72
Standard SRC-806M, No. 102703	C. Mathias 3234 Coronado Ave Imperial Beach CA	5/72
Lafayette HA-410 No. 009210	WA2KDG	5/72
Coll., 62S1 No. 10728	MSU ARC E.Lansing MI	6/72
WRL Duo-Bndr 6010AT302	WA6FCY	6/72

LETTERS

ou goons don't ever proofr
l asy
bu ch of ro ks re n
you ignored my comments in
I insist that you print ev

For the past 3 or 4 years, I have been reading, off-and-on, every ham radio magazine I could find. Last year, a good friend introduced me to 73. Having seen them all, and read them all, I feel that 73 is just about the best there is. I therefore respect your opinions.

For some time, I have been studying for the license, but personal problems always restricted my time. Now I am finally catching up on my code.

Here's my question: If I can achieve 13 wpm (I think I can) would you suggest I try for a General rather than Novice? I have sufficient electronic background to pass the theory. I have heard various arguments for and against; some say that something is missed if one doesn't go through at least a few months as a Novice. What's your opinion?

Dan Case
Erie PA

It sure would be a shame to miss having to buy a bunch of equipment for the Novice bands that you won't need later as a General – and to miss out on the frustration of operating with crystal control (unless you get the Microcomm) . . . and all the other miseries that turn Novices away from amateur radio so they never even get a chance to find out how much fun can be had. Don't miss this educational approach to amateur radio.

I disagree with what was said by W7AR in his letter of July 1972. SSB is the most efficient way to transmit information. It takes up exactly the same amount of space in the spectrum as does the original information. The reason that we need so much spectrum space to carry voice (about 3 kHz) is the tremendous redundancy of speech. The redundancy has its advantage. As in all information transmission systems, redundancy helps eliminate errors. If we have a clear frequency and want to send the most information in the least time, using the minimum bandwidth, we are forced to go to a language with less redundancy. Such is the language of RTTY. With RTTY, you can send more information per unit time per unit bandwidth than you can with voice.

As we increase the bandwidth required by our signal, we increase either the speed of information or the redundancy of the signal. Therefore, I believe that the new breakthrough in communications will not be a new type of modulation, but rather a new language to apply to our old type of modulation.

The reason we don't divide down our voice frequencies for transmission, then multiply them back up upon reception can be explained in several ways. One is that it is not possible to send the same amount of information in the same amount of time on a narrower bandwidth. Another explanation is that all rf multiplication and division is done assuming that the signal is digital, either on or off. This is fine for FM, where there are no amplitude variations, but it will only cause tremendous distortion to AM where amplitude varies.

One way to make voices on SSB sound better is to slow down the transmission speed. Before a QSO, record everything you want to say on tape at 15 IPS. Play it back on the air at 7½ IPS. Have the fellow at the other end record at 7½, then play back at 15. He will find the frequency response to be almost twice as good. We used the same bandwidth at a lower speed.

There seems to be quite a bit of confusion about amplitude modulation (which SSB is). A couple of months ago, Wayne wrote, "How come if you vary the level of the carrier, the carrier doesn't change level," or some such thing about AM. I have almost completed an article that explains all this with a little trig and algebra. Also, I explain the phasing method of generating SSB and the advantages of AM. Yes, AM does have some advantages (redundancy strikes again), but we must use a different detector to take advantage of them. Is 73 interested?

Harold Hallikainen WA6FDN/6
San Luis CA

I don't work 220 yet, but it burns me up that anyone would ever think of giving more privileges to the CBers. Amateurs have to work to get a license, take a test, and keep a log. Why does the FCC push us around?

All a person has to do to be a CBer is fill out a paper. When he signs his name, he can use the band for anything he wants. Excessive power, foul language and illegal antennas – he can violate any rule he wants and the FCC doesn't say much. But, if an amateur violates a small rule, his license is revoked or he is fined.

I think the FCC should crack down on CBers and stay off our backs!

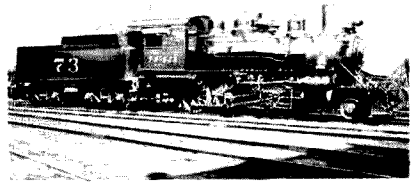
By the way, I think 73 magazine is the best magazine for me! I really enjoyed "Step on the Klutz" by Bob Manning.

Al Wilson WN8LUD
Riverview MI

What really pushed me over the hump to subscribe to 73 was Bob Manning's article in the June issue. Perhaps mine, as well as other ham's subscription, will replace the one that Carl Emerson cancelled.

Thank you and keep up the good articles that are of a general nature and of assistance to the Novice as well as the 2 meter fans.

M. June Zenge WL7HKA
Ketchikan AL



Just thought you would get a charge out of this. Like you said, you never know where 73 will pop up next. This shot was taken in 7-46 at the Frisco Roundhouse in Memphis TN. The engine was built in 1912 and scrapped about 1950. So I hope you're around that long.

Don Wirth WBØECM
Maplewood MO

Could it be that your periodic mumblings about getting out of the business, retiring to other pursuits, etc. have had repercussions in south Georgia?



This photo is of the sign erected at the base of a fire lookout tower located on busy US 301 in Wayne County, Georgia, about 50 miles north of the Florida border.

Read and heed!

M. Wayne Street, Jr. K4QEX
Savannah GA

Great cover on June issue. Let's see more.

Richard Rosenbaum WA2AOI
Jamaica NY

I'm very interested in ham radio and enjoy your magazine.

I m writing concerning the article "OSCAR MARINER on MARS" published in the May issue, in which I understood that there was a manned spaceflight to Mars. Has there really been such a flight? Or, was this article some idiot's idea of fiction?

MORE LETTERS

I am interested in factual information on all phases of radio communication and if this was the author's idea of a joke, then 73 has no place on my bookshelf; it will be 73 to 73 with no 88.

Hilda Dip Chan
New York NY

I have tried all the ham magazines and 73 is still the best all-round publication. Some are all news, some are for geniuses, and some are UGH! half CB. Almost all of the articles in 73 are within my meager knowledge. I am a hard core appliance operator.

My favorite series was the General Class Study Guide. I really enjoy the articles written by fellow hams and I hope they will continue.

Thomas Grabowski K3SPY
APO San Francisco

In answer to your card asking for a renewal on my subscription, I would like to state that I am not renewing this year. I have nothing but complimentary things to say about the magazine and I am sure that it fills a need for many amateurs. However, since I am not in the least interested in RTTY, SSTV or the higher frequencies, I am left with little of interest other than the editor's tiffs with CQ.

Roger W. DeBusk M.D.
K8LSG

I enjoyed solid state construction and Bob Manning's articles are very very good – really enjoy them.

Keep plugging away for us as your efforts are greatly appreciated.

Jack L. Zimmerle WB4QXI
Huntsville AL

You might want to mention in your excellent publication that copies of a U.S. Air Force Medical Service Digest article on Navassa Island activity in February, 1971 are available free of charge by writing to: Richard J. Brown WØEXD/KC4, Pathology, Bld. 626A, NAMRL, Pensacola FL 32512.

Would you like to know why I decided to subscribe to 73? Well, in addition to the articles and ads, both interesting enough, it was the letter by P.T. Atkins, WB2OZW in the March issue. It was the hope that ham radio can have that quality and lead to those kinds of contacts that got me into the business in the first place, which has been confirmed by some great moments within the limited opportunities of the Novice privileges, and which makes me determined to get that General! So, I concluded that 73 would also be of some help to that end.

David A Fee WNØEWE
Brookings SD

I think your magazine is the best. Since you reach a lot of people, maybe one of them can help solve my problem. I've exhausted all the amateurs in this area.

I have a 1969 Chevrolet custom camper with a 396 engine; 18,000 miles on it. In 16,000 miles, I have burned up 6 sets of points and 3 sets of plugs. Even that isn't so bad. The real problem is how to get rid of the S7 level engine noise.

Hope someone can help me.

Keep up the good work.

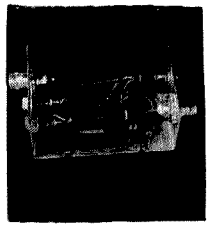
Roy R. Edmiston WA7LUX
Henderson NV

I read about Al Smith (W1GAA) and his problem concerning pirates in the ham business in the June Letters column. I have had a couple of similar experiences and the Post Office handled them with excellent success. In fact, it surprised me. All you have to do is go to your local Post Office claim office with bona fide evidence (cancelled check) and a copy of the order or any correspondence. Tell them all about it and I'm sure action will be forthcoming. No attorney fee either. Hope this is some help in getting your hundred bucks back.

Guy C. Long K9DOF
Elkhart IN

I built the VHF Scaler described in the June 1972, 73 and thought you might be interested in the final construction.





The two photos show the layout in detail. I eliminated the divide-by-100 IC. The unit is powered by a lantern battery. I have already pointed out an error on the bias resistor that was shown as .18k (properly 180 ohms). Incidentally, I have yet to hear from the author on the subject. It would seem that the author should be required to answer and answer promptly; who else can the constructor turn to for answers. If there is any further interest, please feel free to contact me.

Joseph F. Dineen W1JSS
Westwood MA

The idea that you brought out in your recent editorial "Going Through Channels" is really worth a lot of thought and a trial.

A similar idea that may also be worth study and a trial would be to use specific frequencies or channels in each of the high frequency bands for tune-ups. This could decrease the QRM throughout the band by concentrating that form of interference at specific spots. These could be, for instance, in the 7 MHz at 7050, 7225, and 7275. The idea would be to use a standard frequency for this purpose and have enough of them through the band so that the transmitters would still be in tune when the operator goes over to his operating frequency.

This would be similar to the procedure that's used on some nets of having everyone tune-up on net frequency at a specific time just before roll call. This net tune-up, of course, would not apply to an all day net like ECARS. That net operates much more effectively if people tune-up on another frequency; yet, when they do so they are likely to tune-up on someone else.

One idea that fascinates me is operating cross band between two meters and ECARS on 40 meters. It seems to me that it would be fascinating to check in and monitor ECARS on 2 meter mobile.

I enjoy your editorials and your magazine. I think it is the best of the bunch. The other magazines are good, but you are to be commended for being more progressive and innovative. In these times of change we need a magazine such as yours with an editorial staff that is adaptable to the new circumstances of the day.

Keep up the good work.

C. W. Tazewell W4NGU/3
Baltimore MD

On page 34 in the May issue is a mistake which has appeared in your magazine at least 100 times. (This is not much of an exaggeration.) Examine Fig. 5. When you use half of a center-tapped transformer you do NOT obtain one-half of the impedance! For gosh sakes, folks, I cannot understand how a magazine sophisticated enough to include many complicated IC projects can constantly fail to catch this silly, stupid error. It's usually in at least every other issue! Stop it! By perpetuation of this you are doing the industry harm.

Clyde Wade
Little Rock AR

Look here Clyde, you know and we know that halving the winding does not halve the impedance, but since it stands to reason that it should why make waves? Don't be a trouble maker all your life. Besides, this is the only thing that one hundred different 73 authors ever agreed on, so why try to spoil it?

BETTER THAN POT!

Being a college student means I have to give up many things (like sleeping at night, which I probably wouldn't do anyway). However, at the risk of not eating for the next week or two, I have to renew my subscription to 73 (besides I wouldn't want the staff to starve). At any rate, I would completely lose my mind if I couldn't read 73 every month. I have to have at

Caveat Emptor?

Price – $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

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START PACKING! Plane or R.R. tickets, road maps. Got 'em? Then you're ready to take off for the gala ARRL Hudson Division Convention, Oct. 21–22, Hilton Motor Inn, Tarrytown, NY. Plenty of free parking. Exhibits, 2 meter FM, RTTY, lectures, contests, YL-XYL events, gabfests, N.Y. sightseeing, prominent banquet speaker. All ya' need to know from Dave Popkin, WA2CCF, 303 Tenafly Road, Englewood NJ 07631. Free gifts for early registration.

SSTV, RTTY, WWV, tone to logic decoder projects. Chassis, plans, hardware, eight 2¼" x 3" epoxy cards, $6. Hornung, 1630 Bowling Lane, San Jose CA 95118.

GALAXY V, MARK III w/VFO, ac/dc supplies, an $800 package – first $400 gets it ppd. K3TUF, Phil Theis, 3050 Hempland Rd., Lancaster PA 17601.

CINCY STAG HAMFEST The 35th Annual STAG Hamfest will be held on Sunday, September 24, 1972 at the ALL NEW Stricker's Grove, on State Route 128, one mile west of Ross (Venice) Ohio. Check local area map for new location. Door prizes each hour, raffle, lots of food, flea market, model aircraft flying, and contests. Identify Mr. Hamfest and win prize. $5.00 cost covers everything. For further info. contact: John Bruning, W8DSR, 6307 Fairhurst Avenue, Cincinnati OH 45213.

WANTED: Old 3D comic book and viewing glasses. Dave Ingram, K4TWJ, Eastwood Village #50 No., Rt. 11, Box 499, Birmingham AL 35210.

WANT OLD RADIO TRANSCRIPTION DISCS. Any size or speed. Send list and details to Larry Kiner, W7FIZ, 7554 132nd Ave. N.E., Kirkland WA 98033.

SELL: Measurements Corp. Model 760 Standard Freq. Meter; Range 25–50 MHz, 150–175 MHz, 450–475 MHz. Accuracy .0004% @25 MHz, .00002% @450 MHz; .00007% @150 MHz. Excel. condx. w/manual. $395. plus shipping. K2LIU, RD #3 Freehold NJ 07728.

WANTED – Collins 75A2 in mint condition, complete with mechanical filters State best price first letter. Write W4TVZ 339 W. Dixson Ave., Orange City FL 32763.

EXPERIMENTERS Make etched dual in-line printed circuit patterns on your board at home. Quick! Easy! Inexpensive! No taping! Details: STAMP-A-CIRCUIT, Box 113S, Westchester OH 45069.

SLOW SCAN goodies for sale 'scope adapter (June 70 QST) $20. Variable 500 to 6 kv supply $10. 5AMP11 scanner CRT $7. 6217 super photomultiplier tube $3. 5UP1 CRT $4. 55875 Slow Scan Plumbicon w/info $20. Dave Ingram, K4TWJ, Eastwood Village #50 No., Rt. 11, Box 499, Birmingham AL 35210.

TOWERS protected, stops rust 3 years. Zinc galvanize equals hot dip! 16 oz. spray can $3.95. Protect rotors etc. 2 years with wax base rust inhibitor lubricant. 7 oz. can $1.89. Postpaid. HTP, Box 901, Cupertion CA 95014.

VHF NOISE BLANKER. Models available for VHF transceiver and receiver-converter systems. See advertisement in July issue 73. WESTCOM ENGINEERING Box 1020, Escondido CA 92025.

YOUR CALL LETTERS Two sets, for windshield and rear glass. Smart white letter with red outline. Easily installed pressure sensitive decals. $1.00 postage paid, anywhere. Satisfaction guaranteed. Lake Jordan Artists, Slapout AL 36092.

FM IC-20 & REGENCY-2A owners, Now Available, 4 frequency tone burst oscillator, internally mounted. $29.50. Bob Brunkow 15112 S.E. 44th Bellevue WA 98006. Phone (206) 747-8421.

FOUNDATION for Amateur Radio annual Hamfest Sunday 22 October 1972 at Gaithersburg Maryland Fairgrounds.

TECH MANUALS $6.50 each: R-220/URR, R-388/URR, R-389/URR, R-390/URR, R-390A/URR, URM-25D, TS-148/UP, TS-403/U, OS-8C/U, TT-63A/FGC CV-591A/URR, TT-98/FG, TT-100B/FG, UPM-45. W3IHD, 4905 Roanne Drive, Washington, DC 20021.

SELL OR TRADE: Ten Tech PM1, never used, 25 feet heavy duty AC cable, bag used tubes, three TV transformers and USN power supply, S-85 receiver with Q-multiplier. WANT: Johnson Transmatch or equivalent (200 watt minimum), 4:1 balun, and SWR bridge. John Tourtellott, 50 Johnson Avenue, Ridgway PA 15853.

TELETYPE 28ASR Excellent condition. 6 manuals. TT/L-2 TU. $1,100 for lot. Pick-up only. Henry Rainville 106 S. Cornwall Ave. Ventnor NJ 08406, (609) 822-0098.

HAMFEST IN MEMPHIS September 17, State Technical Institute, Interstate 40, east of city. Prizes, flea market, tech talks, MARS meeting, XYL activities, food. 8:00 AM to 5:00 PM. Talk in on 2m .34–.94, .22–.76, 75m, 3.980. Write Evin, WB4VDH, 239 Kenilworth, Memphis TN 38112.

NATIONAL AMATEUR CRYSTAL BANK A central receiving, testing and matching service for exchanging 2 meter FM crystals. Send SASE for details. National Amateur Crystal Bank, Dept. 73, P.O. Box One, Wykagyl Station, New Rochelle NY 10804.

...AND MORE!

least one vice or addiction (it's the IN thing).

I really enjoy your magazine if you haven't guessed that yet. Please keep up the good articles and circuits, especially the circuits since as a physics major I can appropriate the needed parts from the electronic's lab. (They pay me once in a while for working there; not enough – but, there are advantages like good test equipment.)

You're doing a fine job. Keep up the good work.

Kent Croynn

Here is my payment for a subscription. I recently picked up one of your magazines and was surprised at the improvements that you have made. The articles are very up-to-date with FM and state-of-the-art techniques. You stay with the current trends and I'll stay with 73.

David Parker WB4GLO
Grand Farks AFB

All I can say about seeing the K1YSD article in the June issue is that, whenever I open that issue, my eyes are mysteriously drawn to his article where I'm then transformed into a crazed maniac suffering from laughing convulsions. When my friend reads the article, the same thing happens to him. It must be a disease.

Bob Davidson WB8IPR
Chagrin Falls OH

READER SERVICE

Please either tear out this list of advertisers and send it in to 73 with as many boxes checked off as you would like to see brochures, data sheets or catalogs . . . or else make a copy and send that in. Include your zip code, please.

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A few weeks ago while we were in Chicago for Expo-72 Wayne and I had a chance to work through a very fine repeater. The Chicago 16–76, WA9ORC. The repeater features several satellite receivers with a "voting system." I must say, I was impressed with WA9ORC. At the Expo-72 site the ORC gang had a control point set up for talk in and message handling. They had several of their people walking around the vast area with walkie-talkies on a "secret frequency." These people were acting as security for the area. As will unfortunately happen with all the gear on display at a convention, a couple of units were "ripped off." It didn't take long for the ORC cops to get into action. As an example, Wayne and I thought one of our Standard walkies had been stolen. While Wayne reported the possible theft I went out to the car to check on the possibility that we had already packed the unit (which we had). On my way back to the Exhibit I was stopped several times by ORC cops asking to see my Standard. In all, the Expo-72 show was a lot of fun. I understand it was much better than last year. The exhibits were interesting, as were the talks and the Flea Markets. The Flea Markets were my favorite. For a couple of acres all you could see were hams selling their wares. No matter what small part or large piece of gear you were looking for, it could be found. I'd like to say to the Expo-72 group, Well Done.

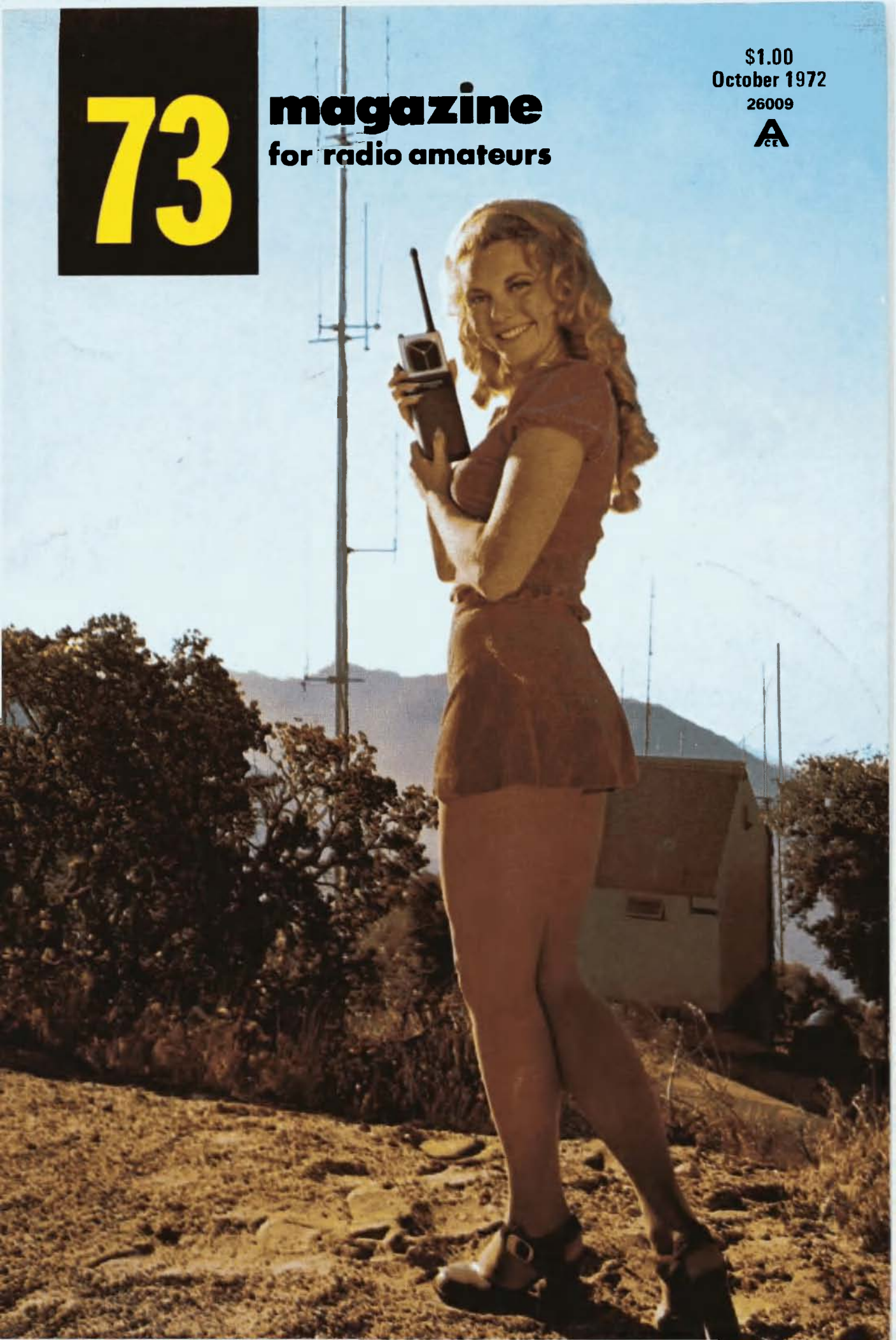
A small problem has developed with the Bajo Nuevo DXpedition. Instead of going to Bajo Nuevo we may go to Serrana Bank, unless some problems with the Colombian Government can be ironed out. I had written to the official amateur organization of Colombia, the LCRA. They sent back their new criteria for a DXpedition to Bajo Nuevo. They are: 1) The expedition leader or Director must be a Colombian citizen; 2) The Director must have a Colombian license; 3) 50% of the expedition members must be Colombian citizens; 4) The expedition must be sponsored by the LCRA. I am told by a member of the last DXpedition to Bajo Nuevo that this action is the result of one Colombian gentleman and it was done for personal reasons. The new criteria virtually makes a DXpedition to Bajo Nuevo impossible. However, there is one more avenue of attack I am taking. We are still planning on Bajo Nuevo but if the problems can not be resolved we will go to Serrana Bank which is not far from Bajo. Serrana Bank will be just as good a DXpedition. I have already received the call KS4BS for Serrana Bank. Either place, the DXpedition will take place. I still need written confirmation from some of you who want to go on the DXpedition. If we do indeed go to Serrana Bank we will have room for a couple more operators. Today, those of you who want to go on the 73 DXpedition who have not written, please do it. If you wish, give me a collect telephone call. We need to start getting the equipment checked out and ready to go. There are a million details to be worked on if we are to have a good DXpedition so please write or call today.

What do you do when you find yourself operating out of band? I would think the normal procedure would be to quietly sneak back in without saying anything. Perhaps no one will notice. This might work if you are a few cycles out of the band. But, what do you do if you are engaged in a roundtable with 5 other stations and you find yourself 10 kHz

(continued on page 72)

73 magazine
for radio amateurs

$1.00
October 1972
26009



73 magazine
for radio amateurs
#145 OCTOBER 1972

COVER: Mary Jane Trokel fondling a Standard 146 hand transceiver in front of the WB6ZDI repeater building on Mt. Wilson. Our thanks to Ron Mayworm WB6NOU, the photographer, and to Fred Deeg K6AEH the president of the Palisades Amateur Radio Club for arranging for the picture to be taken. Again the Palisades Amateur Radio Club does a great public service!

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EDITORIAL BY WAYNE GREEN

Robot Surprise!

The announcement in the September issue of 73 of the Robot plan to sell direct from the factory and thus make it possible to cut the price of their slow scan units to $295 each for the camera and monitor should keep them busier than a skin diver in a bunch of jellyfish keeping up with orders.

That new price tag should help a lot of fellows make the decision to go slow. And don't forget that you don't have to get that camera right off either. You can make do perfectly with a little cassette tape recorder with a tape made up from any neighboring camera.

Hams Don't Build?

The other day an article came in, written by an old timer, complaining that amateurs don't build any more. In the old days the amateurs used to build everything, now they all go out and buy their rigs and just operate them like appliances . . . etc.

This old timer meant well, but he sure was uninformed. I don't doubt that most of the fellows he talks with buy instead of building. The chaps in his club probably do the same. The fact is that not very many old timers do build.

But the newer amateurs are building gear like never before in the hobby.

Now, is Green telling it like it is or is he exaggerating? Who is right? The fact is that you can check for yourself and get the answer in a couple of minutes. Please just thumb through the last sixteen pages or so of this issue and see just how many pages of ads there are for parts. Now, grab the first old timer you see and get him to break out a 30's copy of QST and count the number of pages of parts advertising. There is no comparison whatever. I rest my case. If parts weren't selling and selling like crazy you know darned well that all those companies wouldn't be in there advertising them.

The old timer does not build. With but few exceptions the older amateurs are tube men in the day of the transistor. All they know how to build are tube sets and who would bother to build them today? With the exception of Bill Hoisington and Frank Jones, how many of the old experimenters have been able to convert to solid state?

Our technology has been escalating rapidly. Twelve years ago when we started 73 we had a few transistor circuits – mostly audio amplifiers and code oscillators. The nuvistor was the big news in 1960, if you remember. By 1965 tubes were in the minority and virtually all articles were on transistorized construction. Now transistors are about gone by and we are dealing with integrated circuits most of the time.

Counters which boggled the mind a few years ago now are on one little board. We have the GLB frequency synthesizer on a small circuit board – a complete unit on a tiny board that would have taken a couple relay racks of tubes just a few years ago. More and more ham shacks are now using the digital clocks – clocks that were restricted to laboratories and large computer installations not long ago.

Tubes – transistors – ICs – what's next? Something will come next, of course.

Looking at the latest all IC VHF receiver built by Bill Hoisington, I rejected the article on how hams don't build any more.

Invitation to Steal

Most amateurs are pretty good eggs. Some are rotten. Add to that mix a few "listeners" who can be either and you have a few people monitoring the bands who might be up to no good.

The fact is that there have been several incidents where things went all wrong after an amateur mentioned over the air that he was going to be away from home. The worst case reported was where the amateur mentioned over a repeater in New York that he would be away for the day on a business trip. He arrived home to find his home had been ransacked and his wife raped.

There is a good deal to be said about prudence. Remember that even FM receivers are sold to anyone and everyone. Those little VHF monitors which get the weather and police will also bring in your local repeater – and you – and they could bring unwelcome guests.

FAT NOVEMBER ISSUE

There are a few more ads in this issue of 73 than we expected, so it is a little more packed than we like. This is one of the problems with last minute ads – by the time they come in, unannounced, we have already laid out the articles and have them in negative form ready to print and it is too late to change them.

If the ads keep coming in for November the way they have started, this could be the biggest issue we've ever published. We'll see. We have some corking good articles being readied for this special issue – a whole lot of them. Imagine a magazine as fat or fatter than QST, but with articles instead of operating news, contest results, RACES, IARU, and all that!

And say, if you have any articles in mind which might be of interest for a special FM issue – a surplus issue – an antenna issue – a mobile issue – a CW issue – a VHF issue, then get to your typewriter and get started. We're hard at work right now on these special issues for 1973.

FM DEVELOPMENTS

Old timers are coming on the FM repeaters in droves all over the country. No wonder, of course, since the word has been spreading that here, for the first time in years, is a way to get on the air and have contacts without interference.

Mobile on the lower bands was fun – kind of – if you didn't mind always being the low man, getting stepped on by higher powered stations, losing contacts, and extremely fragmented conversations. About the only gripe on FM is that a few of the repeaters are so busy that rag chewing gets discouraged during the busier hours – but then there are always repeaters that are not being used and which will welcome all but the fustiest of old timers.

The Repeater Bulletin is doing very well, by the way. This is a little publication put out by 73 for the repeater users in the northeastern part of the country. The August issue ran to 48 pages (Radio Electronics size magazine), partly due to the amount of material submitted by the readers and partly due to Wayne Green writing at length. The cover picture of Judi Repeater turned everyone on so much they didn't notice she was talking into the back of her microphone. Shades of Playboy! The most startling announcement in the Bulletin had to do with limiting the circulation to amateurs of high moral turpitude. This far-reaching decision obviously would tend to limit the circulation in certain areas of Connecticut.

Not a little space was devoted to news of the Northeast Repeater

Association, which coverage elicited angry letters and even legal threats of suits and attachment from some of the principles. I really must be careful or I am liable to damage my hard-earned reputation for being non-controversial.

The FCC still is sitting on the promised repeater regulations, and a good thing it is. Virtually none of the problems that they were developed to cure have turned out to be worthy of rule changes, so the whole docket was an exercise in wasted time. Repeaters have not spread out and encroached on AM frequencies and legislation to prevent it is totally unneeded. The fact is that the service provided by repeaters has been so fantastic that there are only a few AMers left on two meters, most of them having long since gone FM, and the emerging problem is how to put the old AM parts of the band to use to keep Citizens Band manufacturers from getting the EIA to try and liberate 144 MHZ for the Ten-Roger masses.

Repeaters have not linked up in long strings either and rules to prevent it would be little short of disastrous at this time. Every time a rule like that comes along today it shoots down a hundred possible future developments that weren't even thought of at the time of the rule. Let's stop this mania for regulation and consider new rules only when things really get out of hand.

The Los Angeles FMers are getting together at last to work out their problems. Hooray! If more of them could pay a visit to New England they would get a good view of what FM and repeaters could be when managed well. New England has turned out to be a model for the whole country on how great FM can be developed. About 70 repeaters are serving over 5000 active FMers and serving them extraordinarily well. Some repeaters have as many as 400 users – others maybe only twenty or so.

Most of the standard thirteen FM channels are active from New York right on up through Boston. If you have a 13–73 crystal pair you can work WA2SUR in Manhattan, WA1KHC in Massachusetts and WA1KGP in Maine. On 04–64 you start out with K2LJC on Long Island, go to WA1KHA in CT, and WA1KGS in Boston. On 25–85 you have WA2PDJ on Long Island, WA1KGY in CT, and K1MNS in Derry NH. Ditto on 37–97, 34–94, 28–88, 22–82, 19–79, etc.

The 220 MHz band is being repeaterized rapidly in an effort to spike the EIA drive to steal the band from us. There are about ten active 220 MHz repeaters in New England and more popping up around the country every week. Clegg and Tempo are building gear as fast as they can. Wait'll you see the Tempo 220 rig in the November 73.

The 73 Tour

We wondered why it was taking so long to get an okay from the Russian tourist agency Intourist confirming the 73 tour accommodations. Finally word came through that there were no rooms available in Moscow. Okay, how about Leningrad or some other city? No, came back the immediate reply, all hotels are filled up. Translation: they don't want USSR amateurs to meet and talk with US amateurs. The group decided to make it Madrid instead of Moscow.

Although the group is still in flux, it now appears that there will be aroud 20–25 going on the trip. It should be a blast – and frankly, a lot of us will be much more comfortable not going to Russia. Few tourists coming out of there say much to encourage others to go. Who wants to be watched and spied on with suspicion while visiting a country – to know that befriending a local amateur might jeopardize his future – to know that other visitors have landed in jail for years through no fault of their own and in spite of everying the U.S. could do. Who needs it?

DISASTROUS DISASTERS

The floods this summer exposed the weakness of our emergency communications. In Pennsylvania all existing communication systems fell apart. Civil Defense was set up in cellars in preparation for bombs and they immediately flooded out. Police and other short haul systems were useless. CB operators tried to help, but lacked any organization or experience and more often than not were a waste of time.

The fact was that, as in most other serious emergencies, the responsibility fell on amateur radio – and amateur radio was ill prepared for the responsibility. They needed short, medium and long-haul communications – which amateur radio is ideal for. Most of all they needed someone in charge . . . this is where things fell apart. Orders were conflicting – great things happened – terrible things happened.

One of the most valuable communications systems set up for the emergency was a two meter FM repeater. Food, shelter, clothing, health and welfare messages, the works, were routed through this repeater. And would you believe that while tens of thousands of people were depending on this there was an amateur in a responsible position in Massachusetts trying his best to keep FM amateurs from driving to Pennsylvania to help?

The Clegg company helped a lot by providing a dozen FM transceivers. These were picked up and flown out by helicopter on the same day that the above mentioned Massachusetts amateur was talking people into not going to help because he heard from a friend that there really was no emergency. . . .Wayne

AMSAT NEWS

Michael Frye WB8LBP
640 Deauville Dr.
Dayton OH 45429

I have been recently informed that A-O-C will again be delayed until November and possibly into early December. This is again due to NASA scheduling.

This column will be just a short rundown of recent happenings since all activities are progressing normally.

I strongly suggest that you at least monitor the AMSAT Nets as quite a lot of current information can be gathered there. If you have specific questions, check in and ask it, someone in the net will probably be able to help.

AMSAT members are working quickly to weld together a stable tracking network. And in my opinion they're doing a great job. Twelve definite command stations have been established around the world so that satellite monitoring will never be out of reach. NASA has graciously let AMSAT use their antennas at Goldstone California for tracking purposes. This will greatly increase reliability of communications.

If you want to work A-O-C the thing you should now be doing is setting up your antennas, and since this project will last through the winter, making sure they will withstand the extremes of your area. Transmitter and receiver operation should also be given a good check. Since A-O-C will accept any mode that appears in its passband maybe this should be looked into. Rumor has it that there is stiff competition going on between a number of groups to be the first to send Slow Scan TV through the satellite. Well I hope the best man wins.

. . .WB8LBP



NEW PRODUCTS

DX ENGINEERING CLIPPER

Quite a few schemes have been developed to increase the average power of the voice for sideband transmission, with the system used in the DX Engineering clipper being one of the more successful and popular.

The problem is that when you set the sideband transmitter to operate properly without splattering, the aver age power is quite low. Only the voice peaks fully modulate the transmitter. A clipper increases the average voice power, effectively increasing the transmitter output power. Indeed, when you check a station using such a clipper or compressor, you will usually see on the order of a full S-unit (6 dB) increase when the clipper is turned on.

Why doesn't everyone use one of these gadgets? Why aren't they built into all of the transmitters? They will be. The NCX-1000 has one built in, so does the Signal One. Unfortunately, the circuit is not at all simple and for reasons of economy it is left out of many rigs.

The DX Engineering clipper is designed to plug right into the transceiver. You unplug the first i-f tube from its socket, plug in the clipper, and replace the tube in the clipper. This adds the clipper to the circuit. The work is done at the sideband i-f intermediate frequency, with a 2.1 kHc mechanical filter built in to reduce the second and higher order harmonic which would otherwise cause miseries.

The clipper is transistorized, so it does not borrow enough power from the transceiver to upset anything. All in all, a clever device. The model presently available is designed specifically to work in the 32S1, 32S3 and KWM rigs. Cost $79.50 from *DX Engineering, 2455 Chico Ave., South El Monte CA 91733.*

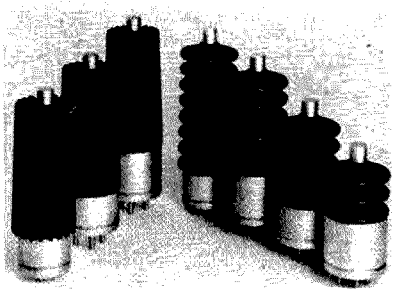
LINEAR IF AMPLIFIERS

A new 4-page product bulletin (IFA-203) describes the expanded line of linear i-f amplifiers available from RHG Electronics Laboratory, Inc., manufacturers of microwave components, receivers and transmitters.

The bulletin contains information on the new line of Hybrid IC i-f amplifiers. In addition to the new products, the bulletin lists new features, improved specifications and reduced prices on many models. Scope photos, performance charts, and outline configuration drawings are shown along with comprehensive and informational technical text.

Bulletin IRA-203 can be obtained from: *Sales Manager, RHG Electronics Laboratory, Inc., 94 Milbar Boulevard, Farmingdale NY 11735. Telephone: 516-694-3100.*

SEMTECH "TUBE-PAC"



"Tube-Pac" is Semtech's new line of silicon, high-voltage rectifiers intended as a direct plug-in replacement part for most popular mercury-vapor and vacuum glass tube-type rectifiers.

Designed to last the life of the equipment, Semtech's Stacks are smaller, corona free, dissipate heat more effectively and eliminate filament power. No special adapters are required to use Semtech's Stacks. For more information contact *Semtech Corporation, 652 Mitchell Road, Newbury Park CA.*

JUNIOR UHF CONNECTORS

When coaxial cable was invented, surely the thinkers of the day had in mind the ease with which rf energy could be coupled from one place to another. As originally planned, the rf coupled fine . . . but what about the coax itself? Was it *designed* to present the mechanical difficulties it does? Specifically, the problem is the copper braid. It sits there and dares you to try and unravel it. An awful job. The only practical solution is to do quick sloppy work and hide it all away inside some sort of connnector.

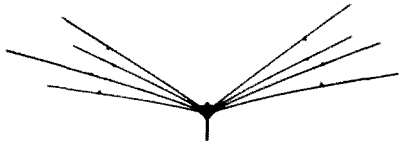
Coax connectors are an item all in themselves. They make coax a pleasure to use once they are installed, but you still have to connect the coax to the connector, etc. This means hasseling with the braid and hauling out the soldering iron. Compare your best effort to the drawings in the Handbook. Now you know why they use drawings instead of pictures!

Offering a partial solution to all this, L-COIL, an antenna manufacturer, has introduced a new line of solderless, no effort coax connectors. They are designed for RG58/59 coax and are compatible with the popular UHF series chassis connectors. To install one, all you do is trim the cable and screw everything together. The only tools needed are a pocket knife and a small pair of pliers. Since everything is held together by pressure, the tighter you screw it together – the stronger your connection will be.

Although most commercial equipment comes with UHF connectors, many hams like to use BNC connectors when they build a piece of gear. Part of the reason is that short interconnecting cables of RG58/U cable look sloppy and are clumsy to use when they have giant PL-259s hanging on each end. Also an amazing number of strange looking adapter cables must be made up to keep everything flexible. These new connectors are a chance to standardize. Use UHF connectors on all chassis, PL-259s on your large coax, and these little beasts on your small coax and interconnecting cables. They are small, light weight and look good.

L-COIL also markets two no-solder splices for RG58 or 59 coax. It's time to piece together all the odd lengths of scrap that's been collecting dust in the garage. According to the test graph supplied by L-COIL (actual test done at University of Michigan), you can end up with nearly virgin cable when using their splices. The graph shows variations of only about 2–3Ω impedance when 50Ω RG58 cable was connected with one of their splices. Their connectors' results were similar. For comparison, they tested two UHF connectors. These gave results of 33 and 37Ω. Send for the graph. *L-COIL Research, Brighton MI 48116.*

M² FOUR BANDER



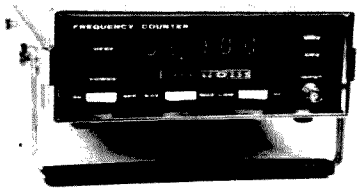
Here is a four band short antenna designed specially for marine use – up on top of the mast. It is a horizontally polarized antenna, a fact which may be appreciated by vertical antenna users. The lower angle of radiation does generally give quite an advantage over most verticals.

The M² is light – only about 15 pounds! – is made of stainless steel to

frustrate the sea breezes – and loads up nicely on 40m up through 10m. It is made up of four "cats whiskers" which stick out from the mast horizontally. Frankly we have no idea whatever why it works and the manufacturer is guarding the secret as "proprietary" information.

The specifications show that an SWR of almost 1:1 can be obtained with the M^2 on all four bands! Since the longest element is only about seven feet long, the antenna is a natural for shipboard use. For more info drop a line to *M^2 Electronics, 28627 Bridle Lane, Miraleste CA 90732.*

SPECTRONICS FREQUENCY COUNTER MODEL YC-305



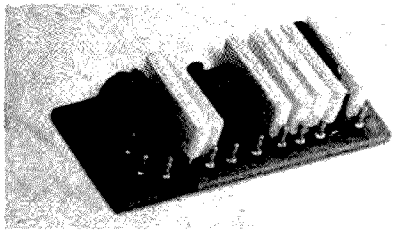
A portable 5 Hz to 30 MHz frequency counter – is being introduced by Yaesu Musen, Ltd. (Tokyo), through the company's North American distributor, Spectronics Inc., Signal Hill, California.

The new counter, designated Model YC-305, features a dual-range system that provides 8-digit measurement with MHz or kHz indications. The unit will operate from a power source of 117V ac or 12V dc. Accuracy is ± time-base stability of 5 PPM ± one count.

Overall size is 8¾ by 3¼ x 10½ in. Weight is 8 lbs. The unit is warranteed for one year and is priced at $249.95.

Further information on the Yaesu Model YC-305 is available from *Spectronics, Inc., 1491 East 28th Street, Signal Hill CA 90806. Phone: 213-426-2593.*

TWO FREQUENCY TONE SQUELCH



Alpha Electronic Services announces the smallest and most reliable two-frequency sub-audible tone encoder/decoder available for the FMer. The Alpha SS-80J dual tone, measuring 2-2/3" x 1" x 5/8" can now provide for many of the smaller mobile units and certain hand-held units two distinct tone frequencies for the purpose of controlling or selecting repeaters, base stations or mobile units.

Two frequency sub-audible tone operation makes possible the employment of multiple repeater systems, increasing the range capabilities of a communications system. The selective calling of two base stations, two groups of mobiles or special control functions are other capabilities of the two-frequency tone unit.

Contact *Alpha Electronic Services Inc., 8431 Monroe Avenue, Stanton CA 90680.*

STANDARD 146A



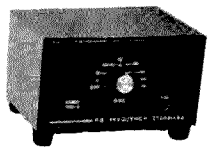
In fact the 146A is remarkably like the 146 hand transceiver. It has the same five channels, the same remarkably sensitive receiver, the same selectivity which keeps it from being clobbered when it is used near a transmitter – it still has that S-meter built in which doubles as a battery monitor – the jack to plug into your station antenna or mobile antenna so you can use the unit anywhere and take advantage of whatever antenna situation you have available – the remote microphone jack so you can wear the transceiver on your belt and use a hand mike – by the way, the regular Standard mike will plug into the 146A in case you have an 826 or other Standard model at home or in the car and want to use the same mike for both sets. There is a jack on the side so you can plug it into the car power while you are running mobile. The whole transceiver plugs into the Standard battery charger or you can easily pull out the battery and recharge it with any small power supply which will put out 50 mA.

The 146A comes with a telescoping antenna, but there is also available a short rubber whip (the rubber ducky) where you don't need as much signal and the shorter antenna is easier and safer to use.

The main difference between the 146 and 146A is that the new unit runs two watts output instead of only one – double the power out! Also there is room inside for an optional continuous tone unit for those of you who work through PL repeaters.

The features of the Standard 146 make it invaluable for many applications. It is by far the best selling hand unit in the country today according to all of the sales figures available. *Standard Communications Corp. P.O. Box 325, 639 North Marine Avenue, Wilmington CA 90744*

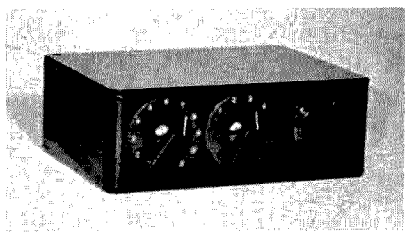
FM FREQUENCY STANDARD



This is a precision frequency standard that has been designed specifically for the FMer. For the first time you can be exact with your channel spacing and deviation. This deluxe standard provides precise markers for both receive and transmit channel spacing for all FM channels in the 10, 6, 2, and 1¼ MHz meter FM bands. An extremely fast rise-and-fall time square wave produces rich harmonics that are usable beyond 220 MHz.

Calibration of the Standard's precision 12 MHz crystal to the National Bureau of Standard's signal from WWV or WWVH is made possible by a simple adjustment provided through the front panel. Price is $44.50 from: *Data Engineering Inc., Box 1245, Springfield VA 22151.*

MODEL 48MV TOP BAND 160 METER ANTENNA TUNER



The FCC's recent initiative to raise power limits and expand frequency

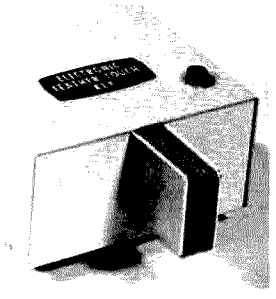
privileges on 160 meters has given rise to a tremendous increase of interest in the Top Band.

A variety of commercial rigs on the market today provide facilities to operate 160 meters, but antenna requirements for the Top Band have always seemed to hinder those hams living in residential areas.

Now, with the development of Top Band Systems Model 48MV 160 Meter Matchverter, any ham having enough room for a 40 or 80 meter inverted vee/dipole can share in the thrill of working DX on the Top Band.

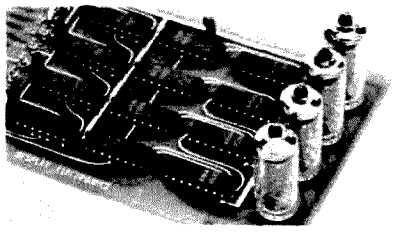
Top Band Systems offers immediate delivery for any quantity of 48MV Matchverters. Write for complete information on terms and delivery: *Top Band Systems, 5349 Abbeyfield Street, Long Beach CA 90815.*

ELECTRONIC FEATHER TOUCH KEY



The Electronic Feather Touch Key is completely solid state. It requires no paddle movement, no spring tension or contact clearance adjustments and has no keying contacts. Keying problems caused by contact corrosion and bounce as well as paddle tension and movement adjustments are no longer a concern. The key is the natural interface for the extremely low current, high speed integrated circuits used in solid state electronic keyers. It sells for $22.95 (with remote spot P.B. switch). *Data Engineering Inc., Box 1245, Springfield VA 22151.*

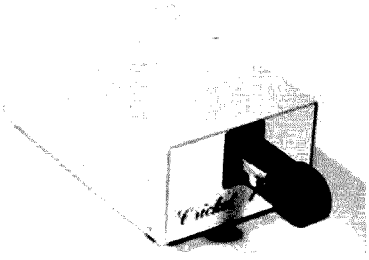
NEW COUNTER AND DISPLAY MODULES AVAILABLE



A new series of counter and display modules is available from Display Electronics. The CM Series modules include a decade counter, latch, decoder-driver, and readout for each digit. Standard modules are available with from 2 to 6 digits.

The price of a typical four digit module is $79.00 in single quantity. Delivery is from stock to 30 days. Custom designed modules are available on special order. Further information is available from: *Display Electronics, P.O. Box 1044, Littleton CO 80120.*

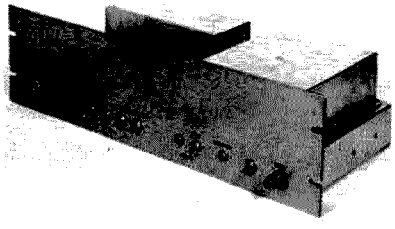
CRICKET 4 MORSE CODE KEYER



This popularly-priced keyer has more features for your dollar than any others in its price range.

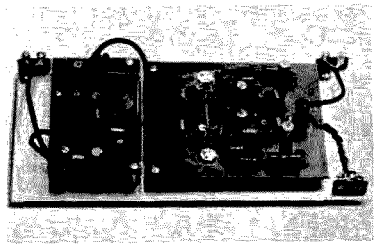
A small solid state keyer designed for the beginner as well as the most advanced operator. It provides the user with fatigue-free sending and it's clean, crisp CW allows for easy copying at all speeds. $49.95 from *Data Engineering Inc., Box 1245, Springfield VA 22151.*

SC-ARPT-1 SOLID STATE REPEATER



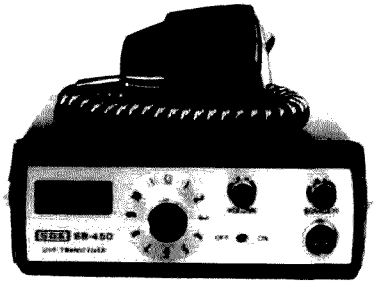
The Standard SR-ARPT-1 is the latest in totally solid state repeaters for the land, mobile and amateur radio communications industry. Constructed to the most critical specifications for years of mountain top, trouble-free service, this unit will provide that extra edge of range needed for even difficult locations. Ready for immediate standard 19 inch rack mounting, the Standard repeater will fit in immediately to your existing communications network. Simply add 12 volts and connect your input and output antennas to the two antenna connections, add the proper crystals, and you are on the air with the finest in repeater communications equipment! Meets FCC type acceptance requirements for land, mobile and amateur radio service. This unit will ideally fit into your communications network and budget. *Standard Communications Corp., P.O. Box 325, 639 North Marine Avenue, Wilmington CA 90744.*

BROADBAND POWER AMPLIFIER KIT



Kit MP-100 is an all solid state broadband power amplifier covering the range of 0.5–100 MHz. Rated at 2.5W CW, it accepts inputs of AM, SSB, Pulse, and other complex modulation. It delivers full power output when driven by any signal or sweep source of 0.15V over the entire frequency range without tuning adjustments. The unit will not oscillate for any condition of load or source impedance and will withstand a 15 dB overdrive including short and open circuit loads. Of printed circuit board construction, the kit can be assembled in approximately 3 hours. A data and specification sheet is available from *Larkton Scientific, P.O. Box 302, Munroeville PA 15146.*

SBE 450 MHz TRANSCEIVER



Linear Systems has developed a new 450 MHz UHF transceiver designed for operation in the 420–450 MHz band. The book sized transceiver is the first SBE entry into the rapidly growing 450 MHz amateur band. The

MARS

Back on 16 February 1972, Wayne Green graciously agreed to allow space for these articles on MARS, beginning with the May, 1972 issue. The writer immediately attempted to contact the Chiefs of Air Force and Navy-Marine Corps MARS but met with little success. Due to more than twenty years membership in Army MARS, getting Army information is no problem but to say that I have met with small success in prying information from the other two services would be to understate the case! To be utterly candid, I have been met with silence. In spite of repeated phone calls and letters to those offices, requesting that I be placed on the mailing list of area bulletins, newsletters, etc., not one word has been received. Therefore I shall continue to concentrate on the information immediately available.

SB-450 comes equipped for operation with crystals for two of the twelve channels already installed. An attractive panel meter provides field strength information. For further information contact *Mr. David C. Thompson, Linear Systems, Inc., 220 Airport Boulevard, Watsonville CA 95076.*

SC-ATBE-1
TONE ENCODER



The SC-ATBE-1 tone burst encoder is a quality unit designed to compliment your Standard, or any other transceiver, for access to the various tone coded repeaters now in operation. It features the five most popular tones currently in use. These may be easily changed at any time for specialized applications. Superior stability employing quality mica capacitors. It comes complete with mounting hardware and connectors to make a neat, under the radio installation. For more information write: *Standard Communications Corp., Box 325, 639 North Marine Avenue, Wilmington CA 90744.*

One thing *was* learned – if you write Navy-Marine Corps MARS at the address shown in the May issue of *73* Magazine – Bailey's Crossroads, VA, your letter will be returned marked "MOVED, LEFT NO FORWARDING ADDRESS!" That address was taken from the current MARS brochure, distributed by the three services. This year, Navy MARS had the responsibility for mailing out Certificates of Merit after Armed Forces Day. Hallelujah! Navy-Marine Corps MARS is alive and well! The return address was right there on the manila envelope! It is: *Chief, Navy-Marine Corps MARS, 4401 Massachusetts Ave. N.W., Washington, D.C. 20390, Mail Stop 394.* Shortly thereafter a very nice letter was received from the Michigan Navy MARS Coordinator Clayton Dewey, giving the same address so it must be official!

One other correction, Army MARS member AA3FMH writes from Germany that it was A3NFX who won the First Army Commander's Trophy rather than A3NFS. The typographical error is regretted.

The deluge of letters from 73 readers concerning MARS membership is very gratifying. I have been slaving over a hot typewriter in all available spare time, answering mail and sending out MARS brochures. Why do I spend all this time and effort? Simply because it is a labor of love! When you become a MARS member, you quickly discover that it's not just another organization – it's a way of life!

Here's a suggestion – if you are in the eastern portion of the nation, listen to one of the fine Pennsylvania Army MARS Nets on 4025 kHz from 6:00 to 7:00 AM EST each morning; tune in the Southern New England Training Net on 4020 kHz at 8:00 AM EST; if you are interested in radio teletype, listen Saturdays on 4035 kHz at 2:00 PM EST. If you live in the central portion of the nation, Third U.S. Army has an area-wide net Monday through Friday from 1:00 to 5:00 PM EST on 7358 kHz – always a very busy frequency. Other Third Army nets begin at 5:00 PM EST on 4001.5, 4020, 4025 and 4030 kHz, on a schedule too complex to explain in this space – suffice to say you can always find two Third Army Nets in operation between 5:00 and 11:00 PM EST. These frequencies are shared with the other Army areas, and when one net is finished, another Army area starts its own operation. The same frequencies are utilized in Sixth Army area – so you can always find some activity!

Better yet – make your plans to attend the Tennessee Army MARS meeting, to be held in conjunction with the Memphis Hamfest on September 17. I will see you there and gladly discuss any MARS matter. For a MARS brochure or other information contact me at:

Harry Simpson A4SCF
73 Magazine MARS Editor
Peterborough NH 03458

HOT GEAR

Stolen early this year: 1) Home-built 2M rig built in a surplus .50 cal. ammo box. 1" diameter black meter with redrawn face in upper right corner; separate Xmit and Rcv oscillators, each with switchable channels. Built from components of RF-401 Series VHF Xcvrs. Has 13 internal nicad batteries. Box is brown except for aluminum plate on which oscillator switches are mounted. 2) Heath HW-100 Xcvr and AC power supply. Marks on top where a bracket was mounted. Also "WAØDAM Sooper Dooper Band Blaster" typed on Scotchtape above the S-meter. Information to Dave McFarland WA2JGP (ex-WAØDAM), 1074 Kenmore Avenue, Apt. 9, Buffalo NY 14216.

List from Past Issues:

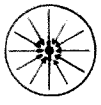
Mfr., Model, Ser. No.	Owner	Issue
Halli, SR46A, No.446100	WA1EMU	9/71
Reg., HR-2, No.04-03505	WA5BNM	11/71
Sonar, FM3601, No.1003	WB2ARM	11/71
Coll., 75A4, No.804	WØMGI	12/71
GE, Portable, No.1041218	K2AOQ	1/72
Coll., 75SE-B, No.15640	Col.St.U.	1/72
Coll, 21S3, No.12000	Col.St.U.	1/72
Coll., 516F1,No.1649	Col.St.U.	1/72
Simp. Mod-A, No.35457	W2PWG	1/72
SBE SB-33 No.103906	WA5JGU	2/72
Heath HW22A No.907-1835	W1BDX	2/72
Nat'l HR050 No.280019	WA5DQF	2/72
Halli., SR160 No.416000-108039	K9YVA	2/72
Drake TR3 No.3858	WA9EYL	2/72
Coll., KWM2A No 13815	ARRL HQ M. Godwin	2/72
Coll., 312B4 No.59920		
Coll., 30L1 No. 40084		
Coll. MPL No. 44507		
Coll. MM1 (mob. mike)		
Misco minispkr.	Sgt. Hopkins Wilm. DE Police	2/72
Swan SW174 No. 416-5	WØAXT	2/72
Reg. HR2A No.04-05896	K4GBL	2/72
Heath SB102,No.132-128107	W.Singer Woodbridge VA 703,491-2257	3/72
Yaesu FT-101 No. 107036	WA2YSW	4/72
Standard 2m FM No. 102703	W6NPV	4/72
Drake ML2 No. 20189	WB2LLR	4/72
Standard SRC-806M No. 009210	K1TLP	5/72
Aerotone 6M 355LT, No. 685064	RR Police Grd.Ctrl.Trml. NYC	5/72
Standard SRC-806M, No. 102703	C. Mathias 3234 Coronado Ave Imperial Beach CA	5/72
Lafayette HA-410 No. 009210	WA2KDG	5/72
Coll., 62S1 No. 10728	MSU ARC E.Lansing MI	6/72
WRL Duo-Bndr 6010AT302	WA6FCY	6/72
HR-2A, 11 chan., 04-07152	WA1NVC	9/72
Swan Cygnet 270,No. 313022	K4ACJ	9/72
Collins Mic, Mod. MMs, No. 4294	K4ACJ	9/72

Microwaves

Amateur Microwave Question

WA600J: *"What is microstrip and stripline?*

The answer to that question is reasonably simple. One day in the 1920's some enterprising amateurs took two different sizes of copper water pipe, cut some rubber supports, slid all three pieces together and, presto, the world's first coaxial transmission line. Later, manufacturers substituted woven braid for the outer copper pipe, polyethelyne for the rubber support, and solid center conductors for the inner copper pipe.



COAX

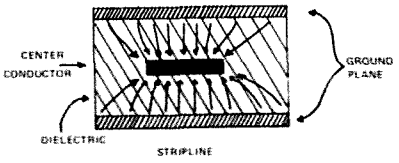
Then they sold millions of feet of this stuff by calling it "coax." We won't argue *why* electromagnetic waves propagate down this stuff, but we will note that the electric lines of force extend *from* the shield *to* the center conductor.

Later (in the '30s) some machinist with time on his hands made some big and small rectangular tubes and rectangular insulators, and, by fitting them together, made rectangular coax. By careful measurement, they found that almost all the electric force lines were crowded in the center, in the narrow gap between the center bar and the closest point on the outer tube (shield). This piece of information was duly noted and forgotten about, because all the engineers and scientists suddenly had their hands full with radar and WW II.



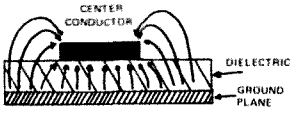
After this war, and the Korea thing, some mention was made of space travel. Now, scientists, engineers, and amateurs (e.g. "OSCAR") were all looking for a way to make microwave printed circuits. Someone remembered this rectangular thing and said this: suppose we make the rectangle thinner and longer, so that the ends have almost no effect on the electric lines. Then let's take away the end plates.

Let us then take two pices of double-clad p.c. board and etch our center conductor on one piece. Now, this "etched" side of the board makes our center conductor, the fiberglass or phenolic becomes the dielectric, and the copper "backing" becomes the outer conductor. This, they said, is a coaxial line in strip form, or strip-line. The impedance of the line could be varied by etching the line wide or narrow; the "sandwich" could be made small by choosing the dielectric as thin as desired. Several refinements have been made to this strip-line. Teflon® fiberglass was found to be one of the best dielectrics, and this board material is now commercially available. Impedance curves, filter design charts, and matching section curves were generated using this double-board approach to microwave circuit design.



STRIPLINE

Then along comes some crazy guy who wonders, what happens if you take away one of the ground planes? Will it still work? Fortunately for the world of science, yes, it will work, and it is called micro-strip.

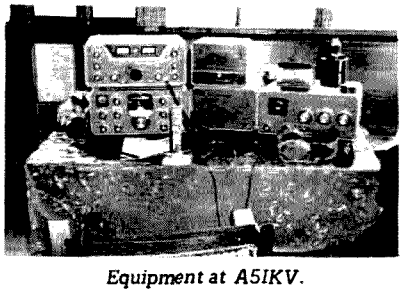


Once again, design curves were generated to make microwave circuits on this type of construction. Then, as different dielectrics were tried, it became apparent that over a 10:1 reduction in circuit size was possible for some of the high dielectric ($E \approx 200$) titanium dioxide type of dielectrics. For some critical space applications, solid sapphire ($E = 9.5$) has been used as the dielectric.

In short, if you take round coax and make it rectangular, you stil have a transmission line. If you take away the side ground planes you have stripline transmission line. If you take away the top cover of strip transmission line, you have microstrip transmission line.

If you have any questions or comments about microwaves, drop me a line.

Jim Weir WB6BHI
Box 23233
San Diego CA 92123



Equipment at A5IKV.



A5ITY, Radha XYL of A5IKV and A5IKV at Thimphu.

The above photos show the people involved and the equipment used in the operation of A5IKV, the DXpedition to Bhutan by Venkat, VI2KV.



Station YV-5-DZZ will grant a certificate to each amateur in each city and in each band for the first QSO contact with VY-5-DZZ or YV-5-DZY. YV-5-DZZ or VY-5-DZY can be worked every day on the following frequencies: 14,300 at 1100 to 1200 GMT, 21,252 at 1600 to 1700 GMT, and 14,150 at 2300 to 2400 GMT. Any amateur who desires this certificate should send a confirmed QSL and either $1.00 or 5 IRC to Francisco Reyes Viada, P.O. Box 517, Barquisimete, Venezuela.

* * *

VQ9FOS Amateur Radio Station will be operating from Mahe during the period Oct. 2–5, 1972 inclusive, as part of the Island's festivities.

Contacts will be offered on 10, 15 & 20 continuously throughout the period, and other bands by arrangement.

A Festival of Seychelles QSL card will be sent to all contacts and your return QSL card should be sent to: Hon. Secretary, Di. Cardell, VQ9DC, Amateur Radio Exhibition, P.O. Box 321, Mahe, Seychelles.

* * *

In response to an inquiry by Senator Goldwater, Chairman Burch of the FCC indicates concurrence with the view that there is minimal AM operation now on the 80 through 15 meter bands and that it might be a good idea to phase out AM by an amendment of the rules. This has been forseen as a forthcoming development by many influential amateurs for quite some time and everybody should be prepared to make their position known to their Directors if and when the commission comes out with a proposed rulemaking. There are potent arguments both pro and con on the subject and it is a step which should be taken without full consideration of every phase of the matter.

SSTV SCENE

Dave Ingram K4TWJ
Rte. 11, Box 499, Eastwood Vil. 50N
Birmingham AL 35210

The real enjoyment of Slow Scan is being actively involved in both operating and building gear. This way you can add the little "goodies" you in particular desire, and possibly in the process stumble upon ideas to further the state of the art. Remember, Slow Scan is one field in which advancement can still be made on an individual amateur basis.

In the same manner spark gap paved the way for CW, and AM for SSB, Slow Scan may be the forerunner to communication facilities of the future. Ever heard of Holography? A three dimensional picture accomplished without lens. The Hologram is reproduced, presently, in a box. The viewer can look above, below and around the image. In fact, you can see as many angles of the object as the viewing windows of the box allows. One can conceivably visualize a system, for example, of color Slow Scan Holography analysis, transmission, and synthesis, where a heart bank in, say Chicago, analyzes a donated human heart and transmits a form of Hologram to, maybe a hospital in London, where an open heart surgery operation is in progress. The synthesized heart is reconstructed in free space (in the future) right above the patient so the surgeons have a guide they can look above, around, and under. The doctor in Chicago can display any sector at will, thus guiding the operation perfectly.

This is well within the realm of possibility and there are rumors of a way around the necessary monochromatic, coherent light (Laser beam) have been uncovered. Light emitting swept diodes? Special phosphor crt? Gee, the latter 1970's and the 1980's are going to be exciting. If slow scan research and communication technology advancements are your bag, check into ideas like Holography. Some companies, for example, like Edmund Scientific Co., 300 Edscorp Bldg, Barrington NJ 08007, have a full line of books and gear that are a "gold mine" for experimenters.

The slow scan directories are out and going like mad. If you haven't latched onto a copy yet, contact Robot Research, or an authorized dealer. The directories are quite nice. Although they list well over 500 active slow scanners, this number has practically doubled since printing started on the book. Some growth, huh?



Photo from KH6HJF received by K3SLJ.

The flying spot scanner article by Taggart in July *73* is destined to be a classic. Already there are many of these units in service. The generator is also used in other gear; the Plumbicon camera, 11LCF flying spot scanner, and another article to be published. If you are looking for a really great snyc generator check this one out. It's a winner.

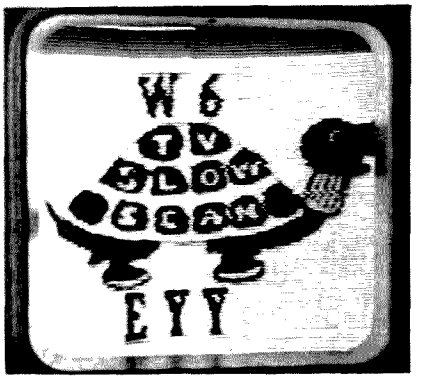
The boys' "down under" are quite busy on Slow Scan these days. Among the most active are: VK's 2BRA, 2GR, 3ARM, 3LM, 3ARD, 3AMC, 3TE, 4NP, 4XV, 5BX, 5MF, 6ES, 6CS, 7JV, 7TB, 8KK, and 8CW. ZL population consists of ZL1DW, 1AOY, 4MB and 4CU. A good many of these are not listed in the directory, so you might want to write in their calls. You can feel sure if you drag them out of a pile-up, they will be glad to swap pix. Most VK/ZL activity is on 14.230 and 28.680 MHz. Weekly net meets on Sundays, 0100 GMT. I understand a company in Melbourne has invented a new phosphor, designated P26, which can even be viewed in bright sunlight. They re-phosphor and re-gun CR tubes for a reasonable sum. I am still checking into this and will give you more information later.

If you would like to really dress up that home brew monitor, take a look at the bezels made by Millen. Designated 80073, for 3 inch tubes and 80075 for 5 inch tubes these two piece units really give a professional appearance to any monitor.



Al WØDRT (St. Louis) as seen by K3SLJ.

The most popular method of operating slow scan is to run audio and video consecutively, thus gaining the advantage of watching the pictures closely, then talking about them. But this is not the only method. Some of the fellows have run audio and video simultaneously – audio on one sideband and video on the other. Another less elaborate method is to run the audio 10 to 15 dB below the pictures (it sounds like a weak station in the background). There are any number of simple ways to mix two audio sources, from 3 resistors (like I use) to a ten dollar mike mixer, so I will not go in to circuit details here. All you need is to have another slow scanner watch your pictures, while you lower your mike level. As soon as your audio drops out of "picture interference" you have all adjusted fine. Then the front end of the monitor will get the video, and you can still be heard talking "down under" the slow scan signal.



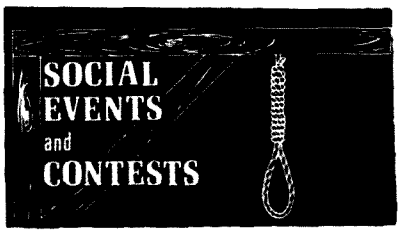
W6EYY identification as received by K3SLJ.



Jane, ten day old daughter of Bill Arrasmith W6TEZ as seen in PA by K3SLJ.

Slow Scan on FM? Fine, closed circuit! Through repeaters? Sure, I checked into this months ago. A SSTV signal is no more than an audio signal. Deviation is the same as voice. If the repeater is within deviation limits, so is the slow scan. If an excessive audio level of slow scan is introduced into a repeater, it merely goes into clipping. And two is fine for Slow Scan experimenting.

. . .K4TWJ



The Hilton Inn at Tarrytown, New York, will be the site of the 1972 ARRL Hudson Division Convention on October 21 and 22. There will be exhibits, lectures and a banquet. Technical experts will be on hand to explain the latest gear. Registration is $3.00 and is required for forum attendance and special events. Banquet tickets are $10.00 in advance, or $12.00 at the door. There are free gifts to early registrants. To register or for more information contact Dave Popkin, WA2CCF, 303 Tenafly Road, Eaglewood NJ 07631.

The Pony Express award is available to all amateurs who make contact with five St. Joseph, Missouri operators. General and above can look for contact individually or on the CHC-FHC Service Net on 3943 kHz about 0200 GMT. At present there are only six Novice operators who are active. Novices wanting this award can look for WNØHNO WNØDPS, WNØDNE, WNØDNC, WHØHEF and WNØGGD on the following frequencies: 3710, 27120, 37130, 7158, 7166, 7168, 7170, 7176, 7180, 7186, 21110, 21120, 21132, 21150, 21170, 21177, 21180, 21200, 21220 and 21240.

The MOUNT AIRY VHF RADIO CLUB, Inc. presents the first annual Pack Rat Hamarama, Sunday October 1, 1972, at the Warwick Fire Co., Jamison Pa. The Warwick Fire Co. is located on Rt. 263 above Willow Grove and is easily accessible from Rts. 309, 202, 611, 132 and the Pa. Turnpike. Activities include a giant flea market, auction and an amateur TV demonstration by the leading local ATV'ers. Festivities begin at 10 AM. Food concession on premises. Registration is $1.00, flea market tables or tailgate sales, $2.00. Talk in on 146.94 and 52.525. For further information contact W3ZD at 520 Centennial Rd., Warminster, Pa. 18974.

The 10th Annual Greater Bay Area HAMFEST will be held at the Royal Coach Inn, just off the Bay Shore Freeway, on October 14th and 15th. For further information contact Veikke West, K6ORP, Box 751, San Mateo CA 94401.

The Quarter Century Wireless Association, Inc. will hold its 25th annual dinner meeting at 7:00 PM, Saturday, October 14, at the Twin Bridges Mariott, located on Route 1 I-95 in Washington, D.C. Senator Barry Goldwater will present the Fifty Year Awards. The guest speaker will be the Hon. Dean Burch, Chairman of the FCC. For further information contact A.J. Gironda, W2JE, Box 394, Mamaroneck NY 10543.

The Moosehorn Amateur Radio Club of the Kenai Peninsula is offering the All Alaska Counties Award. The rules are as follows: Applicant must work one station in each of the four judicial districts plus one member of the Moosehorn Amateur Radio Club. Each two-way contact must be confirmed by QSL card. QSL cards plus return postage are to be sent to Moosehorn Amateur Radio Club, Box 733, Soldotna, Alaska 99669. All contacts must be dated May, 1972, or later.

50 MHz BAND

Bill Turner WAØABI
5 Chestnut Court
St. Peters MO 63376

Andy, VE1ASJ, was much more successful on his second attempt at a DXpedition to Prince Edward Island. The rig held together this time allowing 119 contacts to be made. Best DX heard was WA6JRA, unfortunately no contact was made. Utah and Wyoming were the best DX worked. Jim, W7VDZ, made the grade while VE1ASJ was using 30 feet of wire attached to a dead tree, the regular antenna was a 6 element. Andy has a KW linear in the works which should be on the air shortly. Andy would like to make some contacts on CW in the 50 wpm bracket. Any takers may write him at P.O. Box 51, St. John, New Brunswick.

WA1EXN, Art, says, "I worked W7VDZ for state number 44 . . . also called by K7ICW (I gave him number 50 last year); nice to talk to Al again . . . have heard all the states I need this year but Montana and Hawaii."

Randy, WB4LHF, is on every Sunday evening (0100Z) looking for groundwave, scatter or whatever happens to show up on 50.110. At the same time and day you might look for the North Carolina sideband net on 50.120. Any other six meter nets around?

Earlier this summer I was in QSO with a station in the Northeast who repeatedly wondered aloud if he were being copied. Repeated assurances that his signal was running 20 over 9 didn't ease his mind, his plate current and SWR bridge told him his output was down rather drastically. A few days ago a local ham had occasion to measure the output of his exciter and linear with a borrowed Drake WV-4 wattmeter. To his surprise, the exciter (rated at 180 watts input) measured only 10 watts and the linear (with tubes totaling 750 watts plate dissipation) was putting out only 200 watts. His signal reports from both local and skip contacts had given no indication of this condition. Both the above situations point out the futility of cranking up the MIC gain or repeatedly retuning in order to get a few extra watts output. If you were, for example, running 100 watts output and being received at some distant point at "S9," then your output decreased to 6¼ watts, the net loss in signal strength would be only 2 "S" units. By the same token, if you were being received at "S2" with 100 watts output, an increase to 125 watts would not be discernible and an increase to 400 watts would be necessary to bring your signal up to "S3." From the above it should be clear that any attempt to wring the last watt out of your equipment can result only in splatter, QRM, and hard feelings – not more or better contacts. Higher power is fine, it helps when working groundwave and scatter, it even has a place during skip, just make sure your equipment is designed for the power level in use . . . or a little more.

. . .WAØABI

SCIENCE HALL OFFERS CLASSES IN HAM RADIO

The Hall of Science of the City of New York will conduct a series of twelve instructional and practice sessions for teens and adults in Amateur Radio beginning September 30 at the Hall, 111th Street and 48th Ave., Flushing Meadows Corona Park.

Course for the Novice, Technician, General and Advanced class FCC Amateur Radio licenses will be presented, with all courses scheduled from 10 AM to 12 noon and repeated from 1 PM to 3 PM on consecutive Saturdays.

There is a registration fee of $5.00 and a nominal charge for text books and code practice equipment for participants who require these materials. For further information and to obtain registration form, write or phone *Hall of Science, P.O. Box 1032, Flushing NY 11352 (212-699-9400.*

LETTERS

After working at a TV station for the summer, I have a suggestion for "ham publicity." I have found that even in Rochester (I would assume it is in the top 100 market), there are a number of PSA's (public service announcement), especially in syndicated shows (Star Trek, etc.), which local stations buy and show themselves. These PSA's are picked at random from a supply of PSA's. I presume the showing of PSA's is free as they have nothing better to put there. The PSA's cover a wide range (public libraries, CAP, Army, U.S. Depts., Catholic services, etc.) and I think that amateur radio would fit in well. The best subject would probably be emergency preparedness, but other subjects could easily be used. Near the end we could put an address to contact for further information (such as ARRL) or the phone of a local radio or TV station (there are usually a few amateurs on the staff).

The best lengths for such films would be 60 sec. and 30 sec., however an "oddball" length like 40 sec. might work too.

The project seems a natural for the ARRL, however I mention it to you for your comments and suggestions.

Daniel Kinsella WA2JHF
Rochester NY

Yes, I always have and always will.
Yes, I always have and always will.
Yes, I always have and always will.
(love you)

P.S. I resubscribed

A Resubscriber

As in the "Sorcerer's Apprentice," How Do I Shut It Off? . . . the letters I mean. As a result of my offer to supply transistors to the needy or remotely located – 2 Buck •Gen – August issue, I've sent out almost 250 pieces and have run out. Never believed that many people would be interested. Received another 11 letters today and am substituting the PNP counterpart which only requires battery reversal but I'm afraid my writing arm and envelope licking tongue will not last the 30 days promised – not to mention the transistor supply.

There is sure going to be a lot of QRP 2m FM flying through the air.

I worked 4 blocks into TV channel 13 sound 215.7 MHz with the circuit using a 1X1X1 loop and 1.5–15 pF, so I guess you could say there is 220 MHz activity in Kentucky – almost Al-Al.

Walt Pinner WB4MYL

As a new Novice who also was frustrated over being able to copy only CW on my HW-16, I am now a bit happier. I performed the simple modification as shown in your August 1972 edition for HW-16's to decrease the selectivity, thus making it possible to copy AM/SSB/and foreign BC on 40m. I enjoy it as a change of listening, and it makes copying after a CQ a bit easier.

The only problem is it does result in a little extra "pop" when the key is released, due to picking up the collapsing CW signal. Solid state TR switching is the drawback there.

Keep up the MARS articles. I am a sergeant in the U.S.A.F.

Bill Armstrong WN8NKT/4
Sumter SC

The article on page 119 of the August issue entitled "FM Adapter" was of considerable interest since I am slope detecting FM signals in a communications receiver with a crystal controlled converter ahead of it. However, after reading the article and studying the schematic, I concluded that I wouldn't build the adapter on a bet. Following are the errors I have found so far in this article:

1. Page 119, first line of text – "F" left off of "Frequency."
2. Page 120, schematic:
   2.1 "J1 455 kHz INPUT" designation is confusing placed in front of the input connector ground side contact.
   2.2 Transformer T3, capacitor C10, and the "TUNE" position of switch S2 are not labeled.
   2.3 The V6b designation is adjacent to the lower section.
   2.4 The regulated 150 volt bus is tied to the 2.5 volt AGC delay voltage bus instead of the bottom of R25.
   2.5 The grid pin (1) and the plate pin (2) of V6b should be tied together as this section works as a diode.
3. Page 121, parts list – R24 is a 100,000 ohm resistor, not 1000,000 ohms.
4. Page 122, The sentence "It should be noted that the bandwidth at the receiver output jack is governed by shorting plug can be applied to the output jack when the FM adapter is not in use." is an extra collection of garbled words.
5. Page 123, – Reference 7. Handbook Preferred Circuits, NAVWEPS 16-1-519, (etc.) is NAVAER 16-1-519.

I am going to file the article until all the errata is in, and then will undoubtedly build the adapter. Am sort of disappointed in your proofreading.

Harold S. Eisley WA3SPD/W3NET
Saint Marys City MD

Picky,picky!

Received your proof (New Products, September) and have one correction. Frequency stability of the GLB Model 400B Channelizer is .0005%.

We will have a 5 kHz adapter modification for the Channelizer late this fall.

Bernie Sanders, Sales Manager
GLB Electronics
So. Cheektowaga NY

Enclosed please find my check for a subscription to *73*. After 14 years of interest in amateur radio I finally got my ticket. I was out of touch with the hobby from 1965 to 1972 and was amazed to find all of the changes that have taken place during that time. What I can't believe is the "leadership" provided by the ARRL during this period, despite their motto. To catch up on all the recent developments, I borrowed the back issues of *73* from the library of Dean Metzgar, WB4KAN/3, who also filled in the gaps with a pretty thorough history of what has been happening.

I think what the ARRL needs is a communications system which would *require* each of the section communications managers to report to headquarters two months before every directors' meeting, and also report whenever any major issue should be handled by the league. The SCM's should get opinions on all issues from the amateurs in his area. HQ would then be *required* to compile the 74 reports it receives and the information contained therein would be *required* to be presented at the board meeting.

The real problem in the ARRL is the fact that HQ decides what is good for amateur radio without consulting the amateurs. It all boils down to a "failure to communicate." Maybe they could use some of the league's money to institute a survey system whereby league members would be sent a questionnaire at least every 4 months. Something must be done.

Keep up the good work you've been doing by offering constructive criticism in your editorials, however direct and pointed it might be. You have created the finest amateur radio magazine around. Congratulations, OM.

I just heard from a local ARRL man that the ARRL is going to claim full credit for the development of 2m FM! What a farce!

Herb Brasington WA3TDI

Although it's rather far downstream by now, the article on revising the Morse Code in your November 71

issue has a lot going for it. The author has done a lot of thinking, and certainly from a time-and-motion standpoint is right on.

The chances of getting this done are, alas, very slim. It's the old story – it's easier to walk in the same old rut than to climb out and blaze a new trail. How long have proponents tried to get the U.S. to adopt the Metric System?

Many hams use a typewriter – I wonder how many ever heard about the existence of a superior keyboard, the Dvorak Simplified Keyboard? Its proponents have been trying to get this keyboard adopted by industry and government since 1944, with only sporadic success in getting anyone to listen to them. (I've used this keyboard since 1965, Wayne, and it's great.) It has the same logic and reason and time-and-motion efficiency as the Morse Code proposal. But . . . like all logical and reasonable proposals, this too must await the day when men begin to reason together.

On the basis of bandwidth, the International Code (which is really what the author is talking about, not "Morse") is not yet obsolete, and will be around for a long, long while. I have been a 55-wpm operator (ex-Navy) of International, and 35-wpm Morse (landline) op. Naturally, the code is nostalgic for me, but with great effort to separate the emotional from the rational, I'd be delighted to learn a revised signaling code if it would be as well designed as the new typewriter keyboard. I don't agree with the author's new system, but I applaud his reasoning.

W. Boyd
Geyersville CA 95441

Two meter FM does it again. Through the WA7KZC repeater located on Sherman Hill near Laramie, Wyoming, Chimney Park Scout Camp for the first time, enjoyed two way communication with the outside world.

WA7JYO, his XYL WA7SOH and junior op WA7SUL provided communication between the camp site and camp headquarters. WA7SQJ the junior op's grandmother, operated the town site to complete the family team and communication link.

Wilma E. Hirst, Ed.D. WA7SQJ
Gheyenne WY 82001

I've been reading the 73 License Study Guides – Congratulations on putting out such well written books. I let my license expire while I was away in college back in 1962, but I am again getting very interested in ham radio, especially SSTV.

I remember trying to learn radio from the manuals available back in the 1950's and wondering why anyone would want to write the English language in that fashion. Since that time, with exposure to IBM manuals and Air Force Tech data, I have learned that obscurity and circular definitions are the height of fashion among technical writers. So, thanks for the thought and time involved in putting out such lucid and enjoyable books.

Bert Mayo
Middletown CT

Well, the military can be a real drag, even in London, especially with rising costs and tourist traps within the United Kingdom. However, wherever an amateur goes, whether he is sent on his own volition or otherwise, life can be very interesting. Thank you amateur and thank you *73*. There are plenty of G5 call signs left I am told from the Ministry of Posts and Telecommunications at Waterloo and the price for a year's enjoyment is still the meager sum of three pounds. Even with the monetary crisis the way it is today, it works out to be $7.80. In addition, no renewal applications are necessary. After about two hours and seven phone calls through British red tape and an apparent language barrier between American English and English English, I've found that all they want is for the Anglo-American ham to send the money . . . renewal is taken from there as I understand it.

One might ask what reception is like on this island of islands. The answer I'm afraid has to be that you can work and indeed hear all the Italian stations you wish and perhaps more than you wish. Filters for this human QRM have yet to be developed. Perhaps in this case Johnson Island would have been a better assignment for a ham DXer.

Norman N. North WA1DBR/G5ATR
South Ruislip, England

The comment in the July issue of *73* on FCC harassment of hams, is I feel, grossly unfair to the vast majority of the FCC staff that I have come in contact with in about 37 years plus of amateur, mobile, marine and broadcasting experience.

Like the rest of us, there are some bad people working for the FCC, but there are also and have been many darned nice men that I have had contact with, and it has been my experience that if you are in the wrong, then they will issue the citation, but if it is a grey area, the vast majority are willing to accept the doubt, with just a caution, and suggestion to correct the questionable practice.

Also, as the laws are written by lawyers, different individuals can read different meanings into them, and as a result the individual FCC staffer may interpret them differently, although they do have a guideline for inspections, it still falls to the individual to make an on-the-spot decision if something is right or wrong. I do not envy them this.

There are generally about 20 to 30 DB citations and fines issued each week according to FCC public notices, with just a sprinkling of hams, at the most two or three, and most are for operating on wrong frequencies, or failure to properly identify themselves.

The one thing that has bothered me is the FCC phrase, "For repeated violation of . . . " Apparently once is just a violation, but twice is repeated, even as in amateur radio it takes place, let us say, within seconds, like two transmissions, while if it had continued as a single transmission it would have been only one violation . . . This is again the word against the action.

George W. Brooks W2GX
Newburgh NY

Here's one that might possibly be worth a hint or kink or oddity or something or other. Our small lab has a number of bench power supplies but we are constantly needing another 5 volt supply – and one that can stand a bit of abuse or carelessness, so we have placed several of National's 309K regulators on flat heat sinks with four small rubber feet that we find extremely useful. We punch out holes in the sinks, cut a hole in plastic tape slightly smaller than the stake-ins we use, place the tape on the sink covering the stamped hole, center the stake-in in the hole and fill with epoxy and let set. Then when we need five volts we just strap it across any of the available power supplies between nine and about 38 volts and have a 5 volt current limited power supply. We have a high current regulated supply of 12 volts that can get a bit nasty if you get a bit careless with shorts. I have a small screw driver that is being used now as a scriber to testify to that fact. They are easy to store and provide an instant 5 volt supply when needed. We also have the same units in several other voltages that we use the same way.

73 and congratulations on the continued excellence of *73*.

C.W. Pate
Bryte CA

I am an ARRL life member. This is addressed to all ARRL members, as well as to you to ask for your help in a matter that has been troubling me since last November. That month a guest editorial supporting the ARRL – actually a letter printed as an editorial – by James Russell, W8BU of Cleveland, appeared on page 77 of *QST*. Mr. Russell did a very unfortunate thing in that letter – he owed how we oughtn't only chastise ARRL for its shortcomings, but how we should also stand behind it as the best hope for a strong, viable amateur radio. This would've been fine except that Mr. Russell used the case of a young Cleveland welfare recipient to support his argument. Quoting from the Cleveland 'Press,' Mr. Russell let us know that the young girl con-

(Continued on page 122)

Peter A. Stark K20AW
196 Forest Drive
Mt. Kisco, NY 10549

FREQUENCY SYNTHESIZER for 2 METER FM

Part II

Last month we started describing our frequency synthesizer and gave the parts list. This month we will show all the diagrams and describe how it works, and next month we will have the printed circuit board layout, parts layout drawings, and construction and operation information.

Figures 2 thru 12 show the diagrams of the various parts of the synthesizer. To see how these parts fit together refer back to Fig. 1, the block diagram, in last month's article.

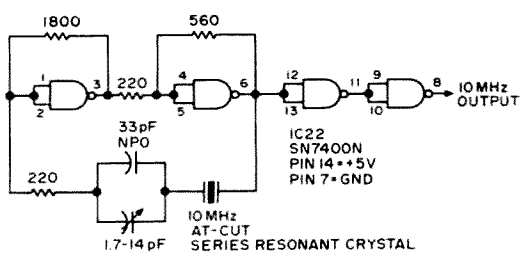


Fig. 2. 10 MHz crystal oscillator.

10 MHz Crystal Oscillator (Fig. 2)

The basic reference for the synthesizer is an AT-cut series resonant 10 MHz crystal in a simple circuit using the four gates from an SN7400N IC. This is a fairly simple circuit which is stable enough for the prupose. If you want the utmost stability, though, you may want to put the entire circuit into an oven. The crystal oscillator circuit is mounted at the very edge of the p.c. board, and so is easily removed later, if you want. But we haven't found this necessary so far.

Reference Frequency Divider (Fig. 3)

This frequency divider takes the 10 MHz signal from the crystal oscillator and divides it down into the reference frequency needed

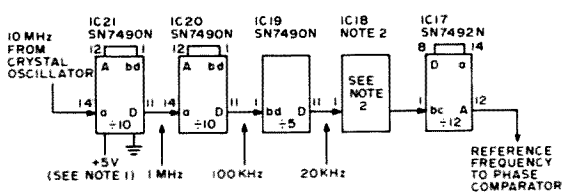


Fig. 3. Reference frequency divider. Notes: 1. All ICs shown have +5V to pin 5, and ground to pins 2, 3, 6, 7, and 10; 2. IC18 type and wiring depends on desired synthesizer output frequency as follows:

Synthesizer Output Freq.	IC18 Data Type	Divides by	Output Pin	Output Freq (Hz) from IC18	from IC17
6 MHz	SN7493N	8	11(D)	2500	208-1/3
8 MHz	SN7492N	6	8(D)	3333-1/3	277-7/9
12 MHz	SN7493N	4	8(C)	5000	416-2/3

by the phase comparator. In our version, which provides 6 MHz output, the reference frequency divider provides a reference frequency of 208-1/3 Hz. For a synthesizer output of 8 MHz, the reference would be 277-7/9 Hz, and for a 12 MHz output the reference would be 416-2/3 Hz. The division from 10 MHz down to these frequencies is done by five IC's. The note at the bottom of Fig. 3 tells the differences in hookup for the three different circuits.

Phase Comparator (Fig. 4)

The reference frequency and the output from the programmable divider both go into the phase comparator, where they are compared. If there is any difference in the two, a control voltage to the VCO changes the VCO frequency to bring it back to the right frequency.

We tried many circuits before coming up with the one in Fig. 4. There are several integrated circuits specially designed for phase-locked-loop applications, and we tried them all. Signetics makes a series of phase-locked-loop IC's which contain the phase detector, several amplifiers, and the VCO all in one, but we found the performance unsatisfactory. Likewise, Motorola makes a phase comparator IC which also did not work out well. An "exclusive-OR" circuit made out of an SN7400N gate package was also disappointing. In each case, the problem is that the output of the phase comparator has to be a pure dc voltage proportional to the phase or frequency difference between the two input signals, while each of the IC phase detectors has a large amount of feed-through of the input pulse signals. While the IC manufacturers claim that you can get rid of these pulses with heavy filtering, that does not quite result in a clean enough output. In our circuit we have managed to eliminate all traces of the input pulses on the output line.

The reference frequency input into the phase comparator is a square wave which is applied to an integrator circuit consisting of the 1K resistor and 1 μF capacitor. These two components shape the square wave into a somewhat distorted triangular wave with curved edges, which is then applied to the source of an MFE 3002 FET. This is an enhancement-type MOSFET which acts like a very fast switch.

At the same time, the output from the programmable divider is applied to the base of Q3. The signal coming in is a series of very narrow pulses (on the order of a tenth of a microsecond wide) whose repetition rate is equal to the reference frequency (when the synthesizer is operating normally). The .001 capacitor in the collector circuit of Q3 widens these pulses to about a microsecond wide, so that the output of Q4 are wider pulses. Between pulses, the output of Q4 is about zero volts, and each pulse goes up to about +12 volts.

These positive-going pulses are connected to the gate of Q1. Q1 forms what is called a "sample-and-hold" circuit. When its gate is held around zero volts (between the pulses from Q4) Q1 acts like an open switch. But during the 1 μS wide pulses, when the gate of Q1 is at +12 volts, Q1 acts like a closed switch. Hence, for a very short instant during each pulse, Q1 connects the 1 μF and the 0.1 μF capacitors together, charging the 0.1 μF capacitor to the exact voltage that happened to be on the 1 μF capacitor at the instant that the pulse occurred.

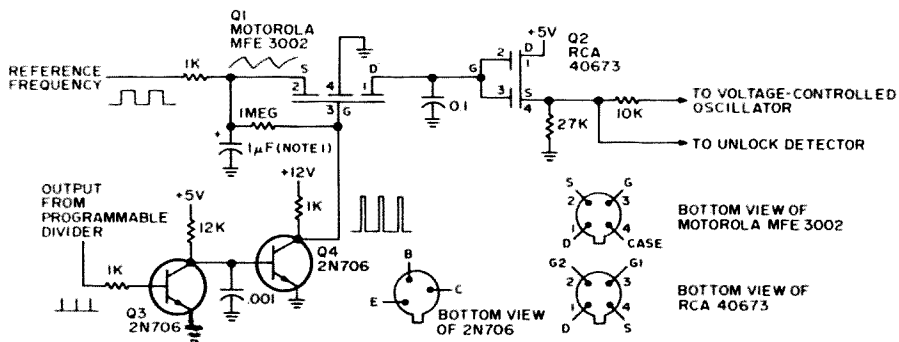


Fig. 4. Phase (and frequency) comparator. Notes: For 8 MHz, change to .75 μF, for 12 MHz change to 5 μF.

If the pulse frequency out of the programmable divider is exactly the same as the reference frequency, then the pulses always occur at the same time in relation to the triangular wave; in that case the voltage across the 0.1 μF capacitor will always be the same, since the FET switch will always sample the same part of the triangular wave. But if the two frequencies are not the same – so that the pulses occur either more often or less often – then the FET switch will sample different parts of the triangular wave, and the voltage across the 0.1 μF capacitor will change.

The output of the 0.1 μF capacitor is connected to a source-follower, using an RCA dual-gate-protected MOSFET, the 40673. The source-follower is very similar to a cathode follower, and provides a very high input resistance to the 0.1 μF capacitor. The purpose here is to monitor the voltage across the 0.1 μF capacitor without loading it down, so that the voltage across the capacitor stays constant even between successive input samplings – this is what is meant by "sample-and-hold." The output from the source-follower is then sent to the unlock detector and to the VCO.

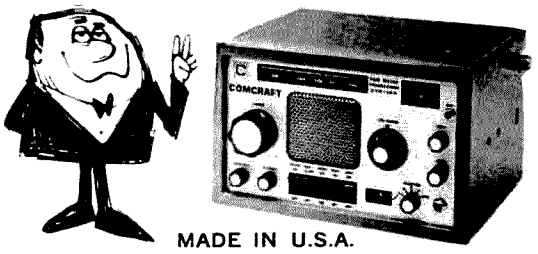
As pointed out earlier, the output from the phase detector is a constant dc voltage when the synthesizer is operating normally. This dc voltage is in the range of about 1.9 to 4.4 volts, and is used to control the frequency of the VCO. Under normal operation, we say the loop is locked on the reference signal. But if the phase detector output is changing, that means that the two inputs into the phase detector were not the same frequency, and thus the VCO frequency is changing. Under these conditions we say that the loop is not locked, and the unlock detector senses this by seeing that the output of the detector is a changing voltage.

Voltage-Controlled-Oscillator (Fig. 5)

The VCO is another tricky part of the system and we must confess that we are not quite happy with this one yet. The heart of the VCO is a Motorola MC1648P ECL oscillator IC, which uses L1 and C1 to set its frequency. The output of the IC is amplified and conditioned by a 2N5771 transistor, and

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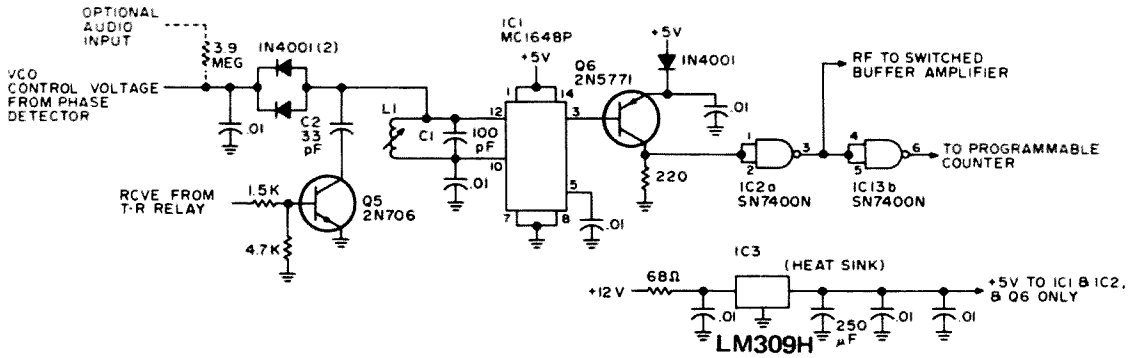


Fig. 5. Voltage-controlled oscillator. Notes: L1 is 26 turns of No. 32 enamel wire close wound on 7/32 in. dia. by 19/32 in. long ceramic core, with ferrite slug (6 MHz output). Coil is adjustable from 3 to 6 µH, and is normally set to about 4.8 µH (6 MHz output).

then further amplified and buffered by some gates before being sent to the rest of the system.

The values specified for L1, C1 and C2 in Fig. 5 are for 6 MHz operation only; we haven't built the 8 or 12 MHz versions yet, and so the choice of coil and capacitor for other operating frequencies will be up to you. We will discuss in a moment the way to decide these values.

The oscillator is tuned over its range by changing the shunt capacitance across the tuned circuit. Instead of using a varicap diode, we found two paralleled 1N4001 diodes just as good. The VCO control voltage (which is positive) is applied to the cathodes of these two diodes. The higher this positive voltage, the lower the diode capacitance, and the higher the operating frequency.

Because the oscillator has to operate at a lower frequency during receiving, we switch in another capacitor, C2, just during receive. This is done by applying +5 volts to the base of Q5, turning it on. When Q5 is off, C2 is essentially out of the circuit, except for about 5 pF circuit capacity.

Since the phase comparator output ranges from about 1.9 to 4.4 volts, we designed the VCO to cover the entire range with a control voltage from 2.2 to 4.1 volts, which leaves a 0.3 volt overlap at both ends, to make sure that enough control voltage is available from the phase detector to control the VCO over the whole range. On our 6 MHz synthesizer, the output frequency during transmit is in the range of 6041 to 6167 KHz, and during receive is in the range of 5595 to 5721 kHz. Hence our VCO is designed to satisfy the following data:

	Output Frequency from VCO (kHz)	
Input Control Voltage	Transmit (0V on base of Q5)	Receive (+5V on base of Q5)
+2.2V	6040 or less	5595 or less
+4.1V	6170 or more	5725 or more

If you build the synthesizer with 8 MHz output, then the transmit output frequency range is from 8055 to 8222 kHz, and the receive range (assuming 10.7 MHz i-f offset) is 7461 to 7628 kHz. Then you will have to change L1, C1, and C2 to get the following:

	Output Frequency from VCO (kHz)	
Input Control Voltage	Transmit (0V on base of Q5)	Receive (+5V on base of Q5)
+2.2V	8055 or less	7460 or less
+4.1V	8225 or more	7630 or more

Notice that in each case we add a little overlap, just to make sure that the final circuit is going to work properly. If you want 12 MHz output, then the output frequencies will be twice those in the 6 MHz case. Also, for 11.7 MHz receive offset, the receive frequencies will be a little lower than those shown above.

In order to keep the noise and hum out of the VCO, we found it necessary to put the VCO into a corner of the board, separated by a ground strip from all other components on the board, and had to install a separate +5V regulator. We used an LM309H regulator with a small clip-on heat sink. The LM309H is similar to the LM309K regulator, but is in a small TO-5 style can instead of the big TO-3 case. You can use the LM309K instead, if you wish, but it will not fit

directly on the board. If you mount it on the chassis, make sure to insulate it from the chassis ground. Instead, bring a separate ground wire back to the VCO and ground it where the LM309H would have been grounded. You must avoid all ground loops to avoid problems.

It is possible to FM modulate the VCO to produce a very nice signal, by simply feeding about 1V of audio to the VCO control input through a 3.9 MΩ resistor. You can reduce the value of this resistor a bit, but if it is made too small then probably you will get hum from the audio input because of a ground loop. In our case, we have a Touch-Tone pad mounted on the case, and this is where we bring in the audio. If you want to voice modulate the VCO, make sure to put in a cut-off filter into the audio path to cut off below about 500 Hz. Any audio introduced at this point that is at a lower frequency than the reference signal at the phase comparator will appear as an error in the phase-locked-loop, and the loop will try to correct for it. You won't get much modulation, and it will just make the loop a little more unstable. We're planning to try to feed in PL tones at this point in the future, but suspect that it won't work out too well.

As mentioned earlier, we are not too happy with the VCO at this point, primarily because it has a little noise. The output has a bit of random residual FM, which shows up on the transmitted signal as a hiss. Since it is not too objectionable we decided to accept it in the interests of simplicity, but may get ambitious on this circuit in the distant future.

Unlock Dectector (Fig. 6)

A relatively straightforward circuit checks whether the loop is locked by monitoring the VCO control voltage. An emitter-follower, Q7, is connected to the control line, with its output driving Q8, an amplifier, whose output in turn goes to Q9 and Q10. Both Q9 and Q10 are normally biased just below turning on. If an ac signal is present, one or the other of these two transistors turns on. In normal operation, pins 13 and 12 of IC13d are at about +5V. If Q9 turns on, pin 13 is grounded; on the other hand, if Q10 turns on, then the input into IC13c

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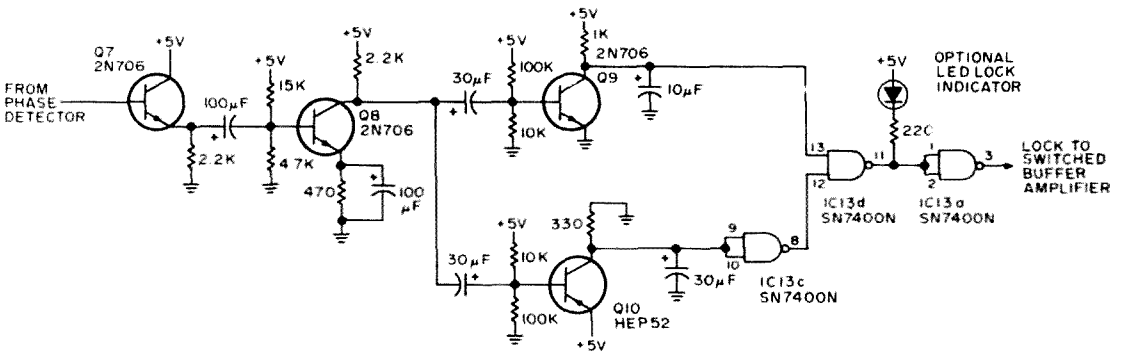


Fig. 6. Unlock detector.

goes to +5V, and the output of IC13c ground pin 12 of IC13d. Either of these two conditions brings pin 11 to +5, turning off the optional LED LOCK indicator, and bringing the LOCK signal, which goes to the switched buffer amp, to about 0V. This LOCK signal is about +5V (a binary 1) when the loop is in lock, and goes to ground (binary 0) when the loop is unlocked.

The optional LED diode makes a very handy way of checking whether the loop is locked or not. There is room for the diode right on the p.c. board, or it may be brought out to the front panel. When the diode lights we have a fairly nice way of making sure that everything is operating normally.

Switched Buffer Amplifier (Fig. 7)

The switched buffer amp uses three two-input gates in IC2 to buffer the output. When the LOCK signal from the unlock detector is a logical 1 (+5V) the gates are on and the rf signal is sent to the multipliers. If the LOCK signal goes to zero, the gates are turned off and the output is disconnected.

Programmable Divider (Fig. 8)

Although this circuit looks the most complicated, it is actually very easy to understand. IC4 through IC7 are programmable decade up-down counters which, along with IC12, do the actual counting. As mentioned earlier, the value of N, the

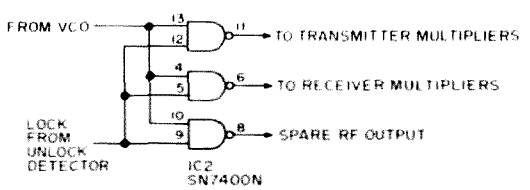


Fig. 7. Switched buffer amplifier.

number by which we divide, is a constant between 29,000 and 29,599 during transmitting, and is 2140 less during receiving. Temporarily forget about what happens during receiving, and look at the numbers 29,000 and 29,599. Since the digits 29 at the beginning are the same all the time, IC12 is permanently wired to count to 2, while IC7 is permanently wired to count to 9. The last three digits of N are entered into IC6, IC5, and IC4, in that order, by the 11 pairs of diodes connected to pins 15, 1, 10 and 9 of those IC's (pin 9 of IC6 is always grounded since that bit is always a 0). The actual connections to those diodes are shown later.

To see how the divider works, let's take an example. Suppose we want to transmit on a frequency of 146.940 which corresponds to a value of 29,388 for N. The digits 29 are permanently wired into IC7 and IC12, the 3 is set into IC6, and the digit 8 is set into both IC4 and IC5. In this way the counter is preset to the starting value of 29,388. As soon as this is done, each input pulse from the VCO circuitry subtracts one from the counter. After exactly 29,388 input pulses the counter gets down to a count of 00000, and we repeat the whole process all over again.

In actuality, there is a bit of fancy footwork required to do all this; to understand all of the fine detail, we have labelled some of the lines in Fig. 8 with letters A through F. After the counter starts counting down toward zero, a number of things happen. First, IC12 gets down to a count of 0; when this happens line C goes high (meaning positive, or about +5V). A short time later, when IC7, IC6, and IC5 all reach

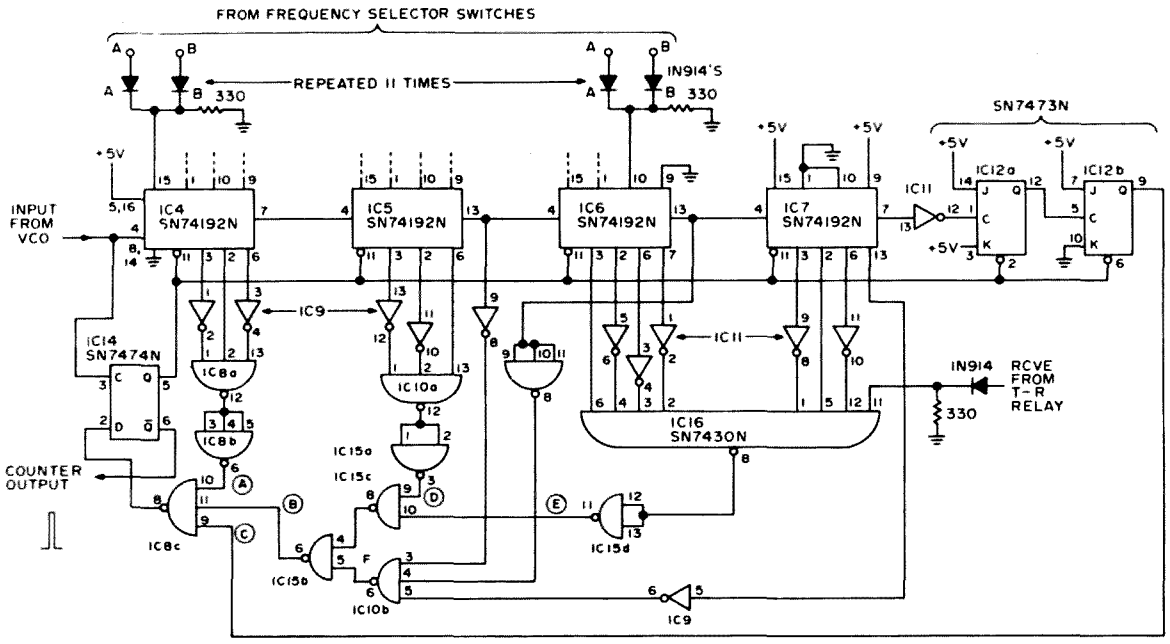


Fig. 8. Programmable divider (÷N).

the count of 0, line F goes low (near zero volts); therefore line B goes high. Then IC4 reaches a count of 2, line A goes high. Thus when the counter has gone from its original preset count down to a count of 00002, the output of IC8c goes low. This applies about zero volts to the D input of IC14, a so-called Type-D flip-flop, but the flip-flop does not react until the next input pulse. At this pulse the counter tries to count down to 00001. But at the same time IC14, which was set until now, resets and its Q output grounds the load lines, pins 11 of IC4 through IC7, and pins 2 and 6 of IC12. This forces all of the counter stages to preset back to the starting value of 29,388. But the counter can't start counting yet – it has to wait until the next input pulse (when the counter would otherwise have been at the count of 00000,) at which time IC14 sets again.

Hence IC14 goes through a complete set-reset-set cycle exactly once every 29,388 input cycles (or whatever N corresponds to the frequency selected), which gives us the frequency division by N. The output from pin 6 of IC14 is a short positive pulse occurring exactly once every N input pulses.

When the synthesizer is switched into receive mode, the T-R relay puts +5V on the RCVE line, which in turn makes pin 11 of IC16 go high. This brings IC11, IC15, and IC16 into the picture. As before, the counter starts to count down from its preset value towards zero, but this time it never reaches anywhere near it. As soon as IC7 and IC6 reach a count of 21, line E goes high. When IC5 reaches a count of 4 line D goes high, and so line B goes high. Lines A and C work the same as before, and so the entire reset process starts when the counter gets to a count of 02142, and resetting finishes at the count of 02140 (instead of 00000 as in transmit). Since this reduces the quantity N by exactly 2140, it drops the frequency (after it is multiplied up to the two meter range) by exactly 10.7 MHz.

If the first i-f frequency of your rig is different from 10.7 MHz, then it will be necessary to change this circuitry. For an 11.7 MHz i-f (such as in the Standard transceivers), for example, we need to start resetting the divider at a count of 02342 instead of 02142. In this case the change is very simple – just eliminate the inverter shown as IC11 pins 5 and 6. Probably the best way to do this on the board is to cut off pins 5 and 6 on IC11's socket to disconnect the inverter, and then put a jumper between pins 5 and 6 on the board.

Notice also that we subtract the count of 2140 from the quantity N, we don't add it. That means we can only accomodate oscillator injection on the low side of the received signal. This fits most imported

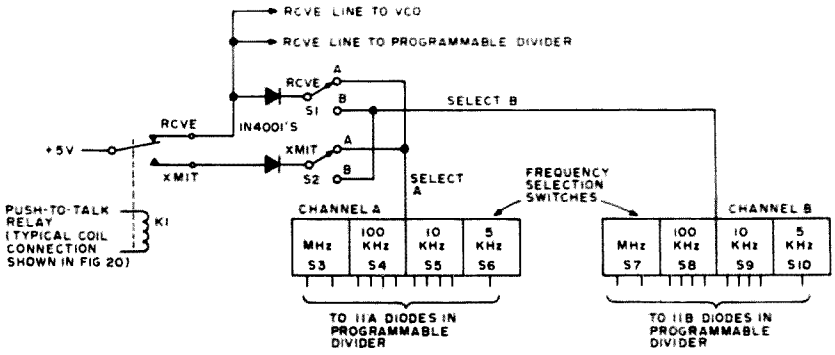


Fig. 9. T-R Relay and channel selection switches. Note: See Fig. 10 for detailed wiring of S3 to S10.

transceivers. But if you own the Yaesu transceiver, which uses high side injection, the changes required to the synthesizer are really major, and it probably doesn't pay to use the available printed circuit board.

T-R Relay and Channel Selection Switches

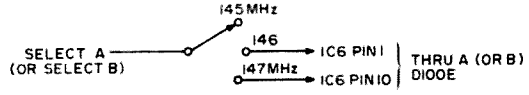
Undoubtedly we could have replaced the push-to-talk relay shown in Fig. 9 with a transistor, but the relay is more universally adaptable to most transceivers, and so we used it. When the relay is deenergized the synthesizer is in the receive mode, and +5V is supplied to the RCVE channel switch S1, to the VCO (to turn on the transistor which switches extra capacitance into the VCO tuned circuit) and to the programmable counter (to cause subtraction of 2140 from the factor N). When the synthesizer goes to transmit, +5V is only supplied to the XMIT channel switch, S2.

The RCVE and XMIT channel switches select either channel A or channel B for operation, and in turn send +5V to either the channel A frequency selector switches (S3 through S6) or the channel B frequency switches (S7 to S10). In this way we get independent frequency selection for transmit and receive, which you need for going through a repeater. For simplex operation you can also preset two different frequencies and simply flip back and forth. With only a little more effort, you could add a scanning circuit which would automatically go back and forth between frequency A and B; it would have to work slowly, though, since the synthesizer takes about 1/4 to 1/2 second to settle on a new frequency (it will take less time if the two receive frequencies are close together).

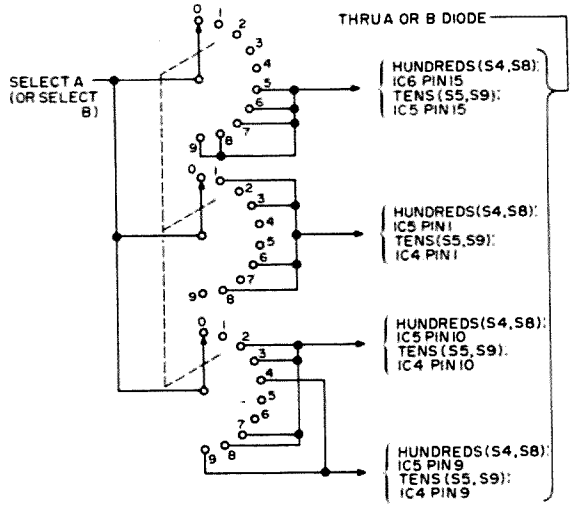
Frequency Selection Switches (Fig. 10)

As shown back in Fig. 8, there is a total of 11 preset inputs brought out from IC4, 5, and 6. Each input goes to ground through a 330Ω resistor, and also goes to two diodes. Of each pair of diodes, one goes to the channel A frequency selection switches, and the other goes to the channel B switches. The diodes are there to isolate the two sets of switches from each other.

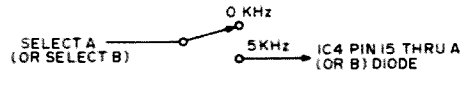
The actual wiring of these switches is shown in Fig. 10. The MHz switches (S3 and



a. MHz selection switches S3 and S7.



b. Hundreds (S4 and S8) and Tens (S5 and S9) switches.



c. 5 kHz selection switches S6 and S10.

Fig. 10. Wiring of frequency selection switches S3 through S10.

S7) are single-pole, three-position rotary switches; the hundreds of kHz switches (S4 and S8) and the tens of kHz switches (S5 and S9) are all three-pole ten-position rotary switches, and the 5 kHz switches (S6 and S10) are single-pole two-position rotary switches. The wiring to these switches is not BCD coding, by the way, and the thumbwheel BCD switches you see occasionally sold surplus can't be used here.

Power Supply (Fig. 11)

The synthesizer is designed to work from +12V, and the power supply consists mostly of regulators and filtering. A simple series regulator using a 2N3055 or similar NPN silicon power transistor is used as a preregulator to keep large changes in input voltage (as in mobile operation) from affecting the unit. The resulting voltage, which is a bit under +12V, is then sent to the VCO (which has its own regulator), the phase detector (where additional regulation is not needed), and to an LM309K IC regulator which provides the +5V at about 0.6 ampere, needed by most of the logic circuitry.

The LM309K in the main regulator should be mounted on a heat sink or on the chassis. The LM309H in the VCO circuitry mounts right on the board, and should have a small clip-on heat sink. The 2N3055 and the 12V zener should also be heat sinked or chassis mounted.

Frequency Multipliers (Fig. 12)

The frequency multipliers take the output of the synthesizer and multiply it up in frequency to whatever value is needed by your transceiver. Since various transceivers need different amounts of multiplication, we

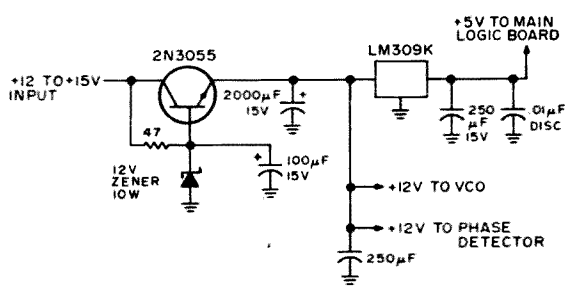


Fig. 11. Power supply.

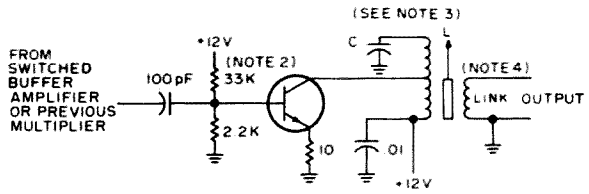


Fig. 12. Frequency multipliers. Notes: 1. Uses components and board of International Crystal PAX-1 rf power amplifier; 2. Add a 33K resistor into holes marked R on PAX-1 board; 3. Select L and C as shown in PAX-1 instructions for range covered. Adjust for max output with synthesizer set for 146.5 MHz; 4. Use 10-turn link with yellow coil and 5-turn link with red coil for coupling to next multiplier. Experiment with correct number of turns on final link to transceiver.

decided not to design our own, but to simply use a commercially available amplifier, the PAX-1 power amplifier from International Crystal.

As shown in Fig. 12, the circuit is quite simple. As it comes in the kit, the amplifier is designed for class C and needs quite a bit of drive. We added a 33K resistor to provide some base bias (it mounts in a set of holes already provided on the board) and found that it works very well as a frequency multiplier. Though it is only rated as being good up to 30 MHz, we found that it works at 45 MHz. In our unit we use four of these units, one to triple from 6 MHz to 18 MHz for our transmitter, and three to double from 5.6 MHz (during receiving) to 11.2 MHz, then to 22.4 MHz, and finally to about 45 MHz. The kit comes with three color-coded coils which cover the range through 45 MHz. But disregard the instructions provided with the kit as to the number of turns in the link, and use the number of turns specified in Fig. 12 between multipliers. The last link, used to couple from the multiplier to your transceiver, will have to be chosen experimentally. If you have an rf voltmeter or high frequency oscilloscope you are in luck, since then you can measure the voltage drive using a crystal, and tailor the link to provide the same voltage.

In the third part of the article, we will show you how the printed circuit board is laid out, where to place the parts, and how to hook the whole thing up.

. . .K2OAW

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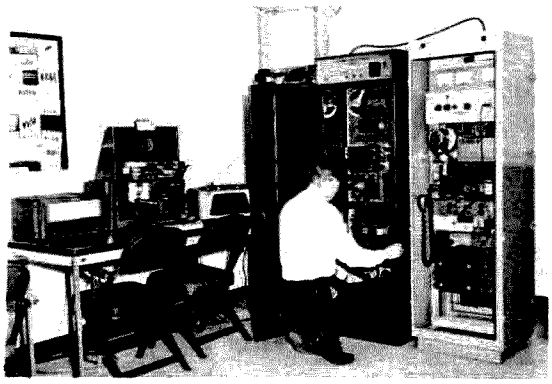
A BIG NEW VOICE IN CHICAGO

A powerful new repeater is on the air in Chicago. It has been established by the Pioneer Amateur Radio Club, a group that has become known more by its QSL cards than by its publicity. Most of the club members are professionals in the communication field, and their club's story is an interesting one.

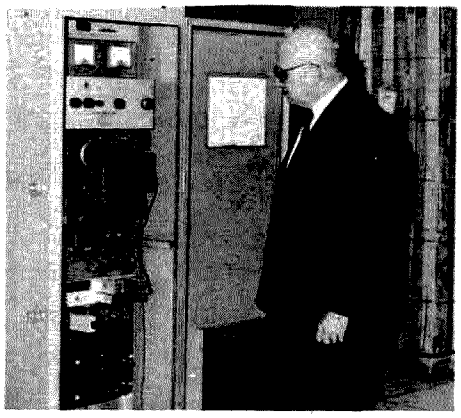
The telephone industry has a sort of old timer's club that has been named "The Telephone Pioneers of America." Membership is open to anyone who has worked in the telephone industry for 21 years or more. Local chapters are numerous and most metropolitan areas are likely to have several. While much of their time is devoted to public service work, they also encourage their members to develop hobbies that will hold their interests in their retirement years. As you might expect, the telephone business has a healthy share of radio hams, and so an amateur radio club made up of active and potential telephone pioneers is a "natural."

In Chicago, the Pioneer organization has made office space available to the radio club and the hams have made good use of WA9PAC has been on the air for sever. l years with CW, sideband, 2m and 3/4m FM equipment. In January of this year, they started regular operation of a repeater under the call WB9AEJ. Talk-out is presently on 449.60 MHz while the talk-in frequency is 449.85 MHz. A change of the talk-out frequency will soon be made to 447.85 MHz. The transmitting antenna is over 500 feet above street level just west of Chicago's loop; and ERP of about 600 watts has been achieved.

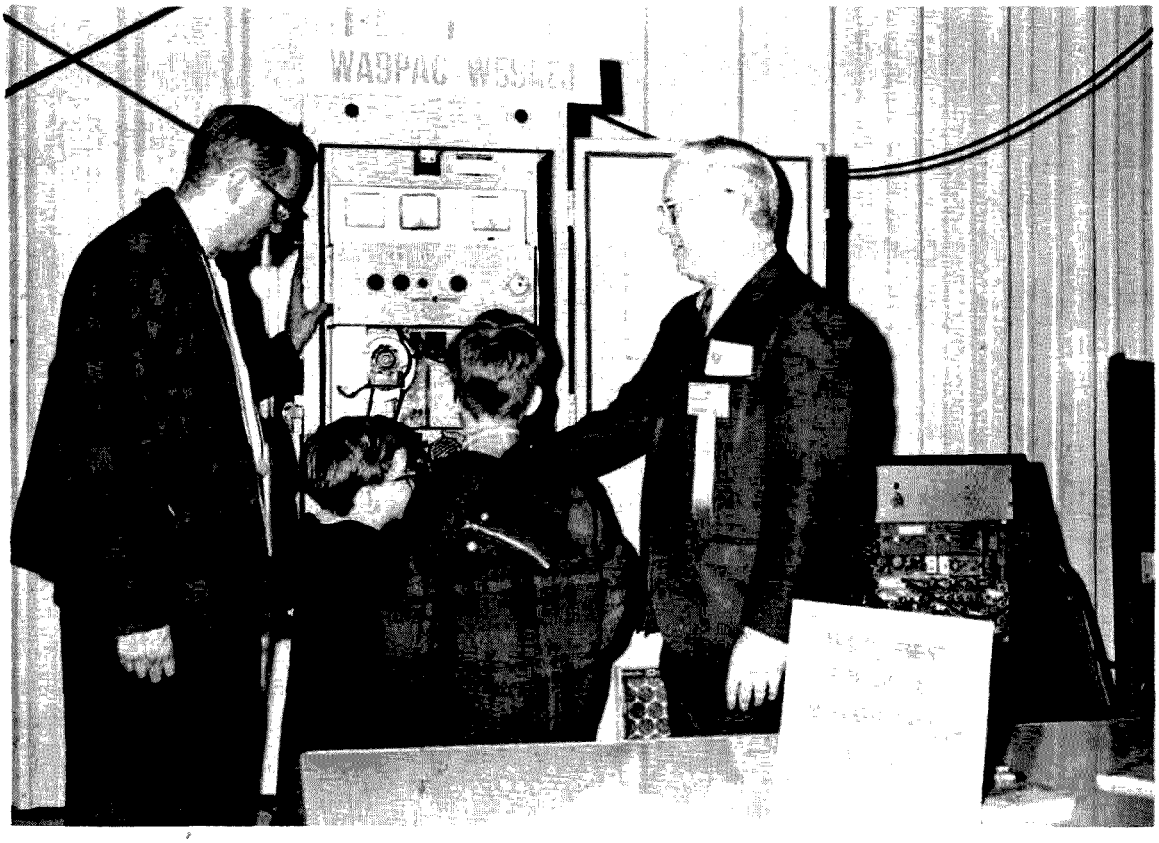
The repeater is open to all users a d is carrier-controlled. Receiver selection ci.cuits prevent more than one receiver from getting



Len Bateman, K9ZNE, makes an adjustment on the automatic voice identifier. The entire cabinet is used as the repeater control terminal; it ties together the base transmitter, remote receivers, wire-line control circuits and the remote control points. The cabinet on the right contains a test transmitter that is used to key up the remote receivers for test purposes. The repeater is normally open to all users and is carrier operated.



Dan Bohi, W9HZJ, takes a quick look at the base transmitter. This rig is located under the roof of a building just off of the west side of Chicago's loop. It transmits on 449.60 MHz with an ERP of about 600 watts. The control terminal and the fixed receivers are in other buildings. This transmitter is part of the repeater that operates under the call sign WB9AEJ. Talk-in is on 449.85. The antenna is more than 500 feet above street level.

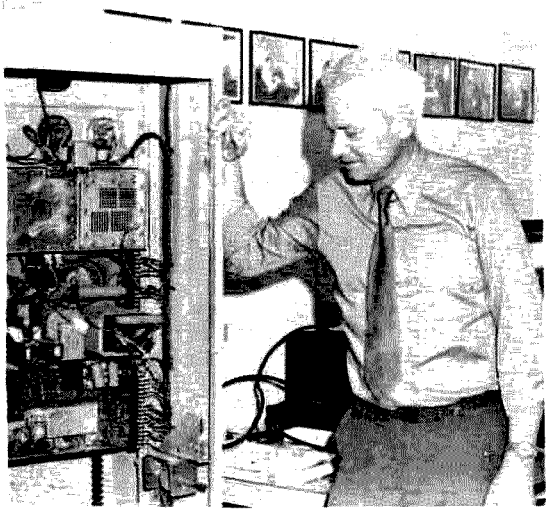


On Sunday, April 9, 1972, portable rigs were on the air from a hobby show in Northbrook, Illinois. George, W9NLT (right) is shown explaining all about ham radio (in 25 words or less) to two young visitors.

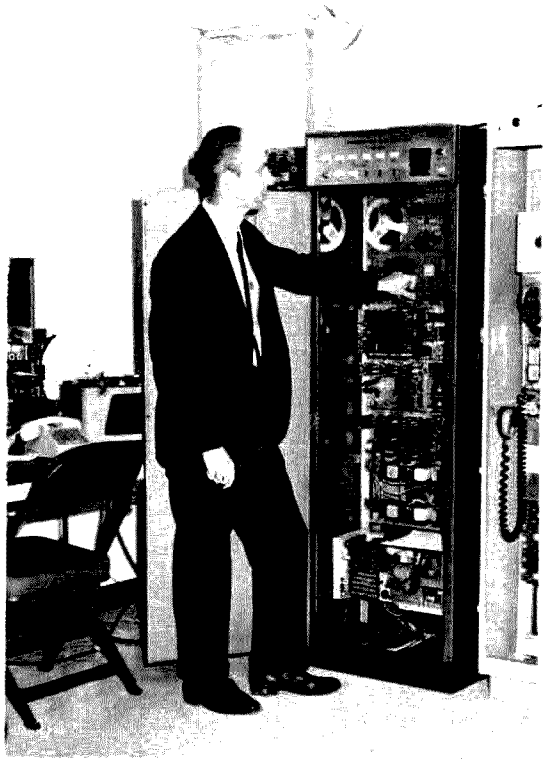
to the transmitter at one time. Another interesting feature is the soft feminine voice that identifies the transmitter. The transmitter is controlled by wire line from three authorized control locations. While only two receivers are currently in operation, the club is hoping to establish two more in suburban locations by late spring.



Ray Fusick, K9FBL, checks out a teleprinter with loving care. On RTTY at home, Ray will be active in work on and with an FSK rig that is being planned for the station.



Bob Klein W9KRZ, may be smiling at the idea that he is looking at a "portable" rig. This cabinet is to be taken to hobby shows and similar displays of spare time activity. It will communicate with other stations through the repeater, WB9AEJ.



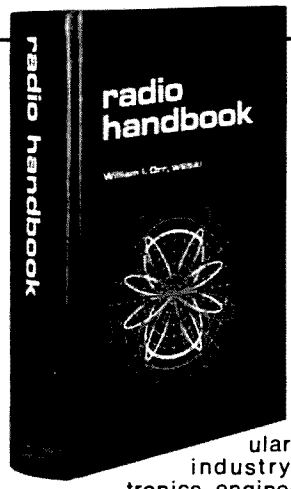
Don Dehn, WB9CXE, has just completed a frequency check on the test transmitter and is shown adjusting the record level on the logging tape recorder.

One activity that appeals to club members is setting up a portable station at hobby shows, hamfests or other appropriate affairs. They have constructed two portable rigs that can be taken out to shows and set up on reasonable notice. Communication will be with other stations via the repeater. Several of the hams in the pictures also work the hobby shows from their home QTH. On March 19, visitors to shows at Glenwood and Oak Brook, Illinois were able to talk through the repeater. Several hundred people were present at each location and the ham exhibit was considered to be one of the main attractions.

Club President Don Dehn, WB9CXE recently announced the results of the seventh annual Pioneer QSO party. With a record high of 446 stations participating, WA9PAC took second place in the club station award category. It was operated by George Hickman, WA9QIA and his son George Jr., WA9QHZ. The Chicago group placed third in the chapter award category.

. . .W9NLT

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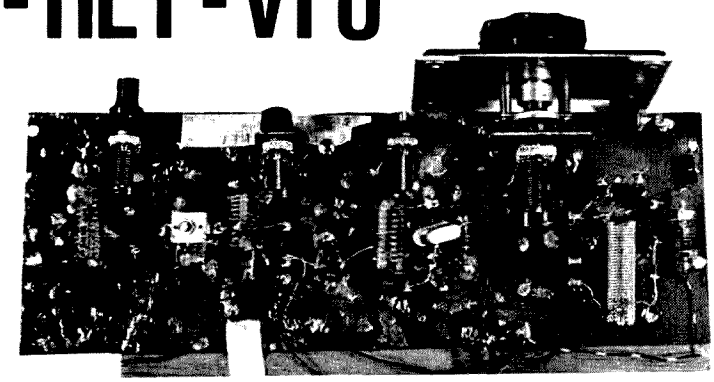
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SOLID STATE 6 METER CRYSTAL-HET-VFO



This describes the basic design, circuit, and theory of a solid state crystal-controlled, battery-operated, heterodyne vfo using low-cost transistors, which delivers a stable 120 mW output from 50 to 51 MHz.

The new Miller two-speed dial is used on the vfo which makes zero-beating a pleasure. A stable oscillator operating from 5 to 6 MHz beats with a 45 MHz crystal oscillator to produce 50 to 51 MHz energy in the mixer output. An rf amplifier brings up this output to 120 mW.

The main feature of this exciter is the *addition* of the stable 5 to 6 MHz vfo to the crystal oscillator, thus avoiding the usual *multiplication* of any shift or drift.

Emphasis is on the basic theory and circuit design. Features that can be added later include a low-pass filter for the low-frequency vfo, crystal switching for greater coverage, direct crystal control, and packaging.

Block Diagram and Overall Schematic

Figure 1 shows the block diagram with the rf output from the 5 to 6 MHz vfo and the crystal oscillator going to the mixer. This type of circuit has been used with success by the military services for many years. It is hard to imagine a better combination of low-cost transistors giving an equally stable variable frequency, easy-to-build, vfo. A tuned amplifier following the mixer serves to further reject unwanted frequencies and amplify the 6 meter energy. The basic theory involved is the use of a variable-frequency oscillator whose output is *not* multiplied but is *added* to a high-frequency crystal oscillator.

This system greatly reduces the demands ordinarily made on a vfo for stability and drift. a 5 MHz oscillator, if multiplied to 50 MHz, suffers from the equal multiplication of drift, FM, hum, or other unwanted modulation, and other

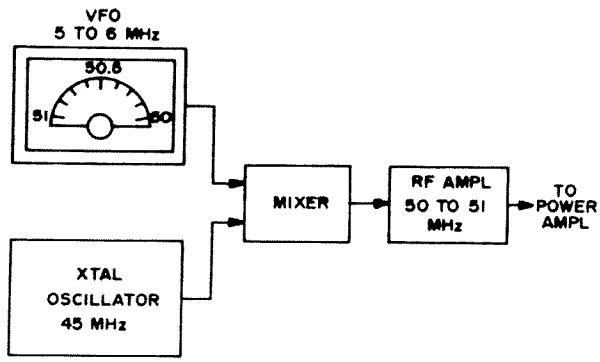


Fig. 1. 6 meter crystal-HET-vfo, block diagram.

undesired oscillator defects. A 5 MHz variable oscillator which is added to a crystal-controlled 45 MHz oscillator avoids this *multiplication* of instabilities.

When two oscillators with different frequencies are fed into a mixer, there are four frequencies always present in the collector circuit. These are F1, F2, F1 plus F2, and F1 minus F2. In the system being described here there will thus be present in the mixer collector 5 MHz, 40 MHz, 45 MHz, and 50 MHz. The mixer collector is of course tuned to 50 MHz, and subsequent amplifiers serve to reduce the other frequencies to an undetectable level at any reasonable distance from the antenna.

The emphasis is on selectivity, using a tuned amplifier to get the desired power output rather than pushing any one stage for maximum power, which is not generally coincident with maximum selectivity. Note the base and collector circuits, which are tapped down on their inductors. This matches their impedances to the proper point on the coils for sufficient power plus maximum selectivity.

In a spare-no-cost design, generally the criterion for military circuits, a balanced modulator is often used, but tests here show that a small number of tuned circuits following the mixer will prevent any detectable amount of undesired energy from reaching the antenna.

The Crystal Oscillator

The question of how much power output to try for here is important for several reasons. First, you would like to get as much power as possible in order to reduce the number of subsequent amplifiers. A famous (for its uniqueness) transmitter, I think pre-WW 2, used one Taylor tube as a crystal oscillator and only *one* more as a kilowatt CW rig! However, contrary to this example of exaggeration, most of today's crystal manufacturers say that a rock should be used only to control the generation of a *small* signal, and that power should be sought in following amplifiers.

Another item is the fact that VHF crystals will drift and/or jump if you try for too much power, as I well know from past experience. Any time that I used more than about 80V on tube oscillators, drift would set in, if not worse, such as jumps in power or frequency, and noise. Dc power of around 800 mW was involved, and if this is used as a criterion for solid state oscillators, we arrive at quite a few mils, using a 12V supply. A power region should be chosen which is not too far below the maximum for the crystal but which at the same time will assure its safety from drift. The way to find out is to try it, which I did, and the circuit shown works in fine style.

Referring again to the Old Days of tubes, a pilot light was often put in series with a crystal to check on the power and to act as a fuse. With today's VHF crystals this is not too feasible, unless some enterprising lads in the electric lamp business make some bulbs with a milliwatt or so of power. Also, as mentioned before, the crystal people are very disinclined to rate their crystals on power, so we're kind of on our own in this matter. The best place to regulate the power of both the crystal oscillator and the vfo, if you need to do so, is with the value of their emitter resistors.

The circuit is shown in Fig. 3. I checked once again both the regenerative and the degenerative feedback circuits and find that the degenerative circuit is more stable and produces more usable power output than the other. Note that if a capacitor is substituted for the crystal, *no* oscillation

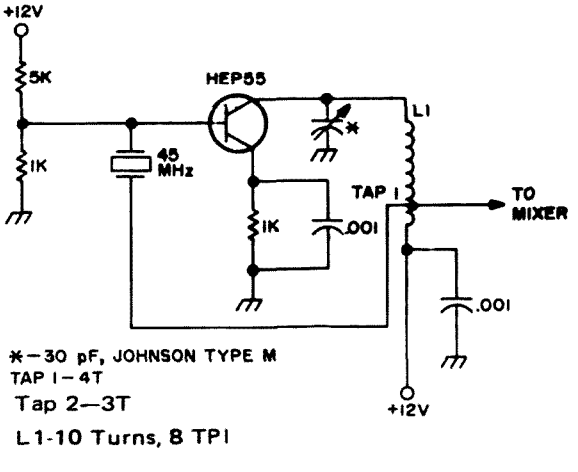
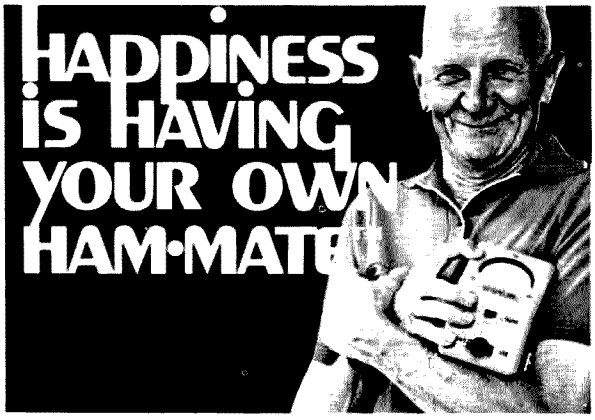


Fig. 3. Crystal oscillator, 45 MHz.

will occur. This is because the base is *in phase* with the collector and the emitter is



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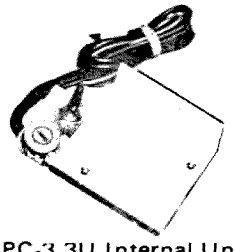
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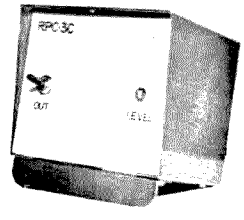
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out of phase with the collector; this is the circuit which is degenerative (also known as negative feedback). As a result of this, until the frequency of the crystal is reached with L1 and C1, no oscillations will occur. The crystal then reverses the phase and the system oscillates. I have mentioned this circuit many times and will probably do so in the future, as it really is sure fire for VHF work.

The Vfo

Here again we shouldn't try for maximum power but instead should check carefully for the power that can be obtained with complete safety against drift. If the transistor heats to any large degree, you can be sure you *will* have drift. There is a well-known complete rig on the market right now which does just that! Fortunately in the rig being described here, I not only keep the vfo at a power which does not heat it up, but I also have a circuit which does not multiply any remnant of instability which might not be economical to remove completely.

Figure 4 shows the oscillator as finally worked out and it is a good one. Reliance is placed on heavy capacitor padding, a standard method for stability but which does call for good capacitors.

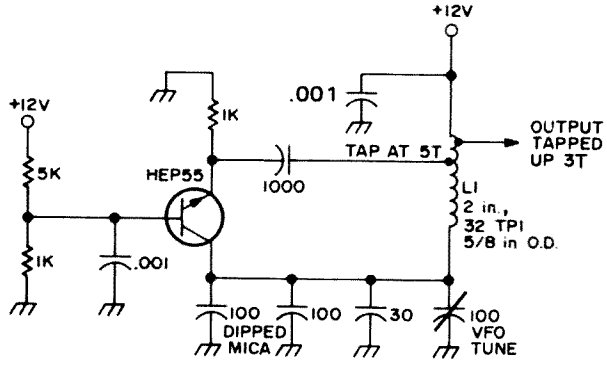


Fig. 4. 5 to 6 MHz vfo.

This unit is the heart of my future 6 meter transmitters, and probably will be for the two meter design as well, along with the Miller MD-4 dial, an automatic two-speed dial and very handy. Using the inductor, padding capacitors, and the 100 pF variable shown, the range tuned is from 50 to 51 MHz. That is, the actual vfo

oscillator runs at 5 to 6 MHz, and the final output from the mixer is 50 to 51 MHz. This is cutting things a shade too close, so add a few turns to L1, cut the padding down a little, and set up something like 49.9 to 51.1 MHz. As mentioned, you can also switch crystals, or get 2 MHz on the dial by increasing L1 still further and dropping down on the padding again. We're just indicating the method here.

The oscillator is very neat and clean and uses the "universal" transistor, the Motorola HEP55. Positive feed is assured by the base connection being out of phase with the collector. It is ac grounded, and the opposite end of the coil from the collector is also grounded. The emitter is tapped up on the coil from the ground end, which puts it in phase with the collector, for the proper relation. The number of turns of this tap up from the ground end controls the amount of feedback. Output is through a tap on L1 which goes over to the mixer base input.

Numerous additions can be considered, such as "battle-ship" construction for real tough mobile environments on boats, planes, etc. An interesting thought is a switch that cuts out the vfo and the crystal oscillator on 45 MHz and switches over to another crystal socket on the front panel for a straight-through crystal oscillator at your choice of fixed frequencies in the band, for nets and round tables. Just thinking out loud – I mean on paper.

As is, this 5 to 6 MHz vfo worked immediately and has given no trouble of any kind since then.

Preliminary calibration of the dial is made easier for beginners who may not have a collection of 50, 50.1, 50.5 and 51 MHz crystals on hand, by the presence on the air of WWV on 5MHz and Montreal, Canada on 6 MHz. This latter is a B.C. station but seems to be audible over most of the East Coast, and probably quite a way to the West. Zero-beating these stations with the calibration dial at 50 and 51 MHz can be easily done with your receiver. Once again, be *very* sure you are on 5 and 6 MHz, because of the possible occurrence of image and harmonic detection in your receiver. Once you have the 5 and 6 MHz logged, you can transfer the dial markings to 50 and 51 MHz. Remember that absorption wavemeter when you do this operation.

The Mixer

Figure 5 shows the circuit. It is not much different from a receiving mixer. The

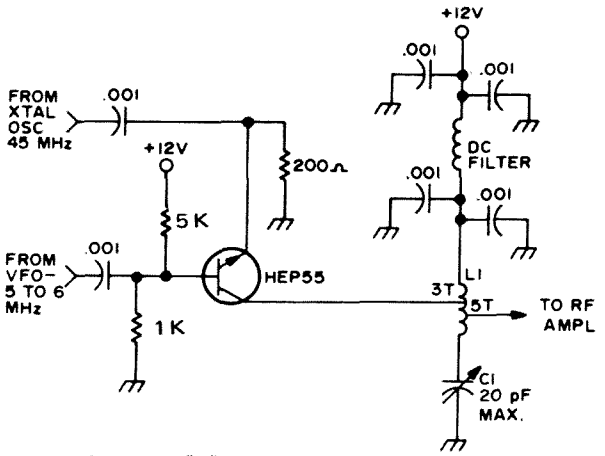


Fig. 5. Mixer, 6 meter-HET-vfo.

signal from the 5 to 6 MHz oscillator is brought in to the base, and the 45 MHz crystal oscillator is coupled to the emitter. Dc bias is furnished by the standard 5K and 1K resistors. The emitter has a 200Ω resistor to ground, which sets the operating point for best mixing.

The collector is tapped on to L1 only three turns up from ground, or cold end, which gives the best output for the 50 MHz beat note. Again, use that absorption wavemeter to check the mixer output. Figure 6

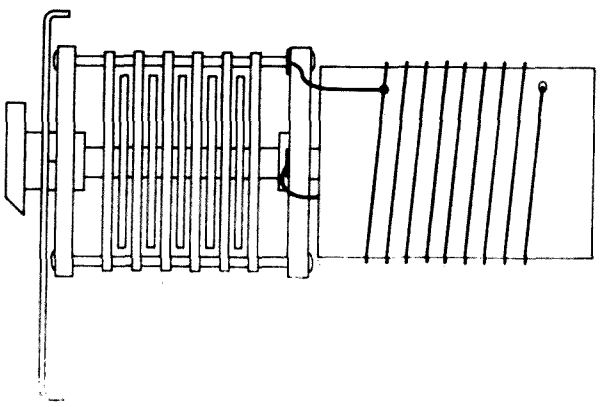
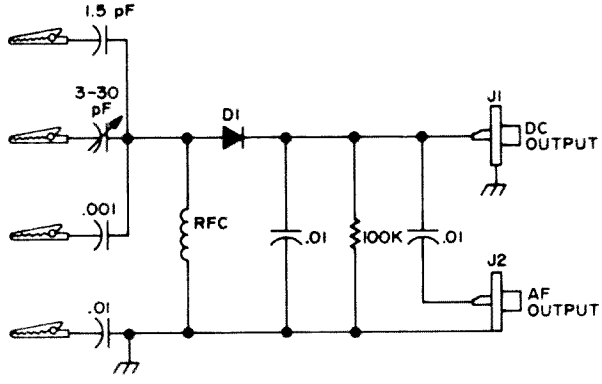


Fig. 6. Sketch, absorpotion wavemeter, James Millen type.

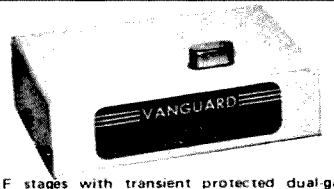
shows what such a device looks like, in the James Millen version, which is the best known. Remember those various outputs that are present in the mixer collector circuit as mentioned above. The 45 MHz energy in the collector can even have more power than the beat note on 50, so don't mistake it or try to use a receiver alone to identify these two outputs, unless it is of the TRF type, like my old favorite – the tuned diode receiver. You *can* use your receiver to listen to these various frequencies once you are *sure* the mixer output circuit is correctly lined up on 50 MHz.



I also listen on an *untuned* diode to note any spurious, squegging, discontinuous jumps in power or frequency, etc. This is a little diode "plank," made up as in Fig. 7. Note the variety of inputs to suit the various frequencies you may be monitoring. For UHF up into microwaves use the 1.5 pF. On VHF and UHF the 3 to 30 trimmer is good For lower frequencies the .001 capacitor delivers more rf to the diode for test purposes. The diode output also has more than one connection. With the alligator clips attached to your rf circuit under test you can thus measure gain with a microammeter plugged into the dc output jack, and listen to what is going on at the same time with a small af amplifier plugged into the audio jack. This can be really vital as you go up into the UHF region. RCA's excellent book, *Transistor and Diode Manual* has the following remarks on these subjects: "Various instabilities can occur in transistor frequency multiplier circuits, including low-frequency resonances, parametric oscillation, hyster-

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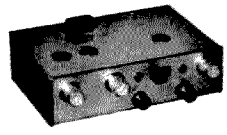


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esis, and high frequency resonance." Hysteresis refers to "discontinuous mode jumps in output power when the input power or frequency is increased or decreased." So don't be downhearted if you find troubles in your solid-state building projects. You're not alone!

There will be more of this cautionary material, so keep reading, and try to understand what I mean by "smooth tuning." You really need it with solid state devices.

When everything is working right, the mixer collector or circuit *does* tune easily without those discontinuous jumps. But watch out for that 45 MHz which is just a little up on the mixer capacitor knob from the 50 MHz point.

Expect in the neighborhood of 10 mW output from the mixer.

The RF Amplifier

Refer to Fig. 8 for the schematic. This one adjusts fairly easily once you get the base input capacitor adjusted to the right value. Start with a small amount and increase it a little at a time. The collector

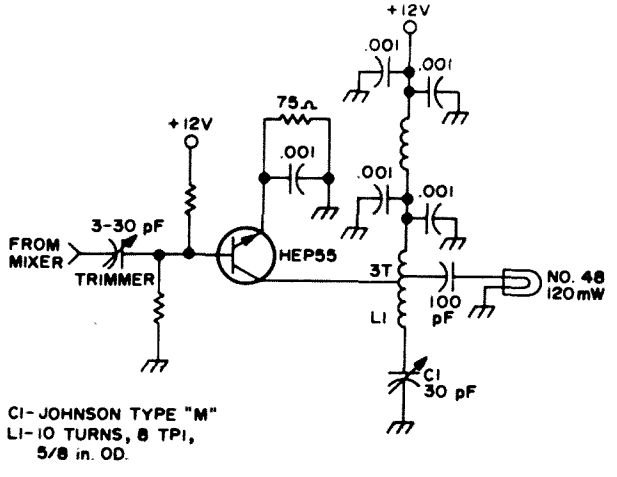


Fig. 8. Rf stage, 6 meter-HET-vfo.

tap should then be adjusted to the proper place and C1 tuned to 50 MHz. The collector tap can be left at three turns from the cold end if you do not wish to check it yourself, as it is not too critical. The No. 48 rf output test bulb is critical as to match though, as you will see.

Due to the normal internal feedback of transistors this stage can oscillate easily, so start with the input capacity at a small value, keep tuning both the mixer collector and the rf stage collector, and push the power up gradually with a temporary pot of 500 or 1000Ω in the emitter in series with the 75Ω shown. If everything is right you will find 50 MHz output when the collector circuit is coupled to a tuned diode detector. Keep increasing C1 until you come to the condition where self-oscillation occurs, then back off a little. The tap on the mixer coil can also be reduced from 5 turns above ground to a lower number at first. As it is now, in final adjustment, both circuits tune nicely without oscillation and are not critical.

This stage can be modulated in the usual manner, but I advise a Motorola HEP75 with a dissipation of *three* watts and a cut-off frequency of 800 MHz as a following stage. It puts out 600 mW on 432 MHz so you can expect at least a watt or so on 6.

Breadboard Layout

Figure 9 shows the layout exactly as built up here, and working fine. There is plenty of room for changing all the values

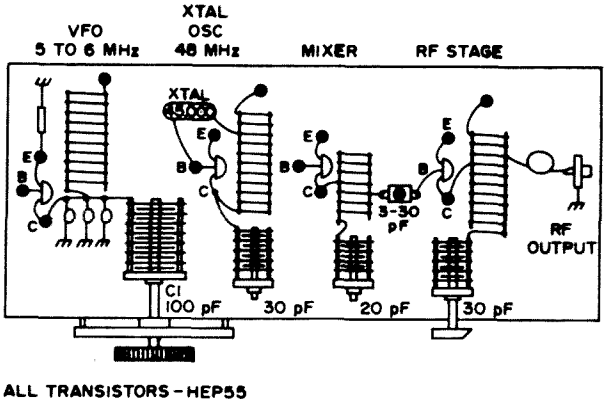


Fig. 9. Breadboard layout, 6 meter-HET-vfo.

as needed, testing transistors, and selecting another set of components for packaging in a minibox. The ground plane works as it should, with no ground-loop currents noticed so far. You can see the four separate stages on the breadboard and check out the individual operation of each stage by itself if you need to. Their packaging in a small box should not be difficult providing a little shielding is used correctly. Of course, nothing stops you from putting this one on the air as is.

...K1CLL

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THE FET VOLTMETER AS A NANO-AMPERE METER

The Field-Effect Transistor voltmeter, an instrument which has an imput impedance of 22MΩ on all ranges with a full-scale deflection of 0.5V on the most sensitive range, is an extremely useful device and one that all hams should build. An added application of this instrument is as a nano-amp meter for measuring the gate-to-channel leakage of individual FET samples. This leakage current (called I_{GSS}) is quoted on the manufacturers' specification sheet as being 2 mA maximum for the 2N3819 and 20 mA maximum for the 2N3820 with 15V applied. This small current is just about impossible to measure using the usual selection of ham test equipment.

The I_{GSS} of a FET sample can be measured directly by using a 15V dc source and a K3LCU FET voltmeter. The circuit diagram shows the hook-up. The source and drain are connected and in effect the gate-channel junction is being tested as a reverse-biased diode.

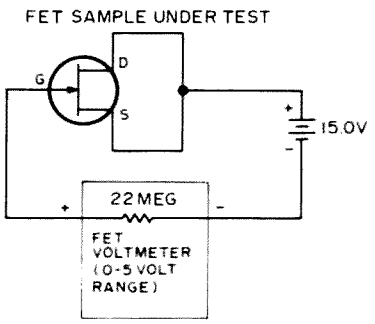
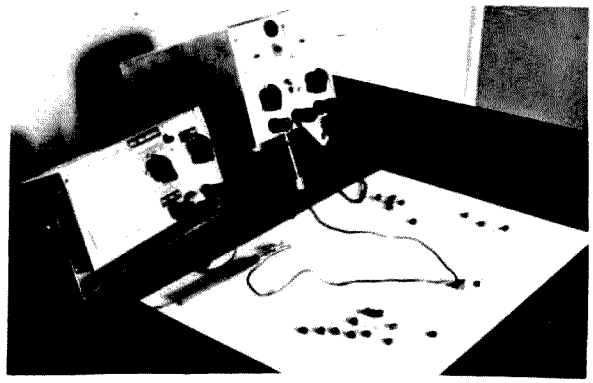


Diagram: The circuit of the I_{GSS} test. Note that the FET voltmeter is set to the 0.5V range and reads as 22.72 nano-amps full-scale. Polarities shown are correct for an N-channel device. If P-channel devices are to be tested then the supply connections and the meter connections must be reversed. This is most easily done by reversing the transistor socket connections.



The photograph shows my version of the K3LCU meter (see *73* July 1966 issue) – one of the handiest instruments I have ever built – and a home-built regulated low-voltage power supply. I have a transistor socket with suitable leads attached that I keep for this I_{GSS} measurement. The FETs are plugged into this socket and the I_{GSS} is shown on the FET voltmeter. I_{GSS} is temperature-sensitive so the reading depends upon the applied voltage and the junction temperature as well as the quality of the device junction. In practice, faulty FETs are very quickly sorted out.

The full-scale reading on the FET voltmeter is really the current corresponding to 0.5V applied across 22MΩ. This works out at 22.72 nano-amps. For the 1.0V range on the FET voltmeter, the full-scale represents twice this current (45.44 mA).

This test will help to sift out the good ones from the surplus FETs now available.

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TIME/FREQUENCY MEASURING SYSTEM

PART I
system concepts



This is the first of a three-part series describing the component parts of a time/frequency measuring system for a well equipped amateur radio station and workshop. The goal is to obtain an accurate station clock and frequency counter which can be calibrated by the amateur in his own shop; the reasons for organizing the system as it is are given in the following paragraphs.

Two pieces of equipment are used: the GMT clock/time base, described in this month's article, and a 220 MHz frequency counter to be described in Parts II and III. Each of these items is useful by itself, but they are intended to work together as shown in the system block diagram, Fig. 1. This system will provide the amateur with a time and frequency measuring system which he can maintain accurately to better than one

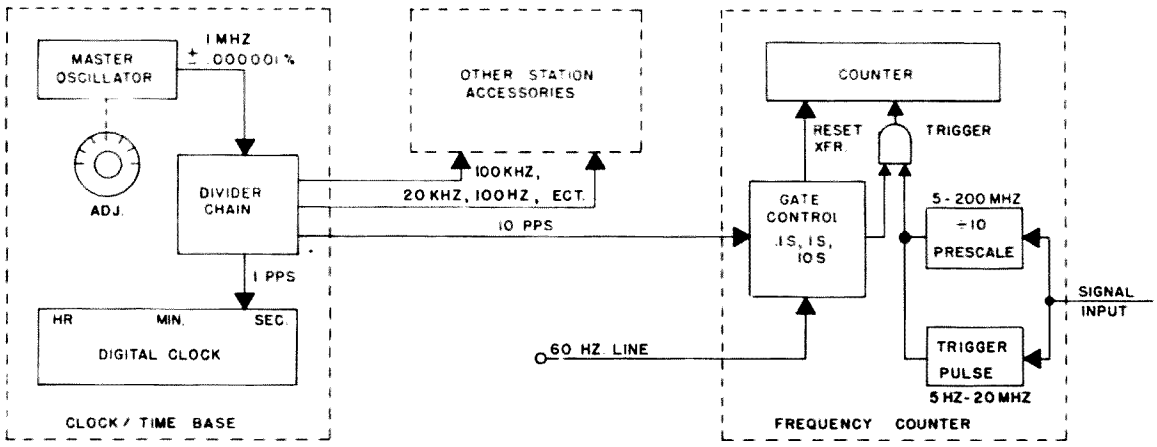


Fig. 1. System block diagram.

part in 10^6 (.0001%) with only a WWV receiver and a little patience.

There is no need to elaborate on the usefulness of a frequency counter, as it is fairly well recognized. This counter is different from most others in that it works to 220 MHz and has a different approach to the time base. The counter is intended to be used with the companion time base to get the specified accuracy, but has provision to use the power line for a reference with reduced accuracy (.01%) for use away from the home shop.

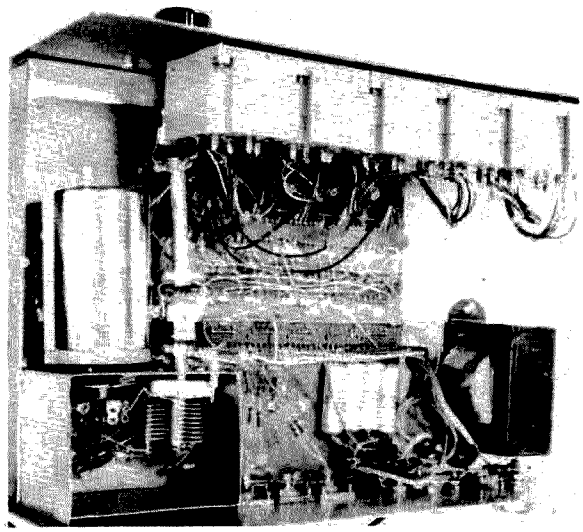
The 6½ digit counter features a Schmitt trigger, narrow pulse generator, and 10 second gate for accuracy at very low frequencies, a 1 second gate for low and medium frequencies, a 0.1 second gate (with kHz decimal point) for high frequencies, and a divide-by-ten prescaler for VHF. A decimal point is automatically set in the display to agree with the switch setting. A latching storage register is used to give a steady display as in all modern counters. Most circuitry is transistor-transistor logic (TTL) integrated circui (IC), with some discrete transistors in the trigger/pulse amplifier.

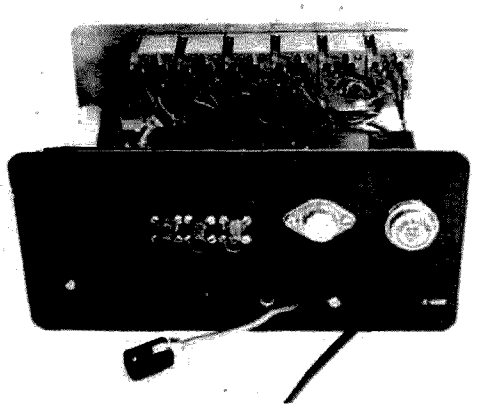
The clock is a 24-hour digital with hours, minutes, and seconds readouts, and also can be used to run remote slave readouts. All circuitry is IC, mostly TTL. The time base is a crystal oscillator with oven, followed by a divider chain to derive the specific trigger periods needed by the rest of the system. A battery power backup is used to prevent losing clock timing in case of ac power interruptions.

Besides the frequency counter, there are other uses for precision frequencies: VFO calibrators, phase-lock loop synthesizers, crystal substitutes, oscilloscope markers, etc. One station time base can run all of these.

Accurate Home Calibration

The clock is combined with the time base to provide a monitor on the accuracy of the time base, allowing the amateur to perform his own very accurate calibration. One part in 10^6 is 0.6 seconds per week, so weekly checks on the drift of the clock versus WWV provide a means for gradually getting the time base oscillator "right on." After several months of occasional adjustments I have achieved a drift rate of less than 0.1 second per month in my own unit, which is better than one part in 10^7 (.00001%).





The time drift calibration method may seem a little tedious, requiring several weeks to months to achieve good calibration. There is actually very little to it, however. In my case, I spend about five minutes every Sunday morning listening to the one-second ticks on WWV and comparing them to the time changes on the clock. When the clock shows drift of more than 1/4 second from the previous week, I adjust the oscillator vernier control slightly in the direction to reduce the error, reset the clock to synchronize with the ticks, and wait another week. Many weeks go by with no adjustment required at all. If I miss a week, I just double the allowance for the next week.

It may occur to some (who haven't tried it) that one could calibrate an oscillator to any desired degree of accuracy by zeroing harmonics of the oscillator's output against the WWV carrier. This has been the classic method for many years of checking HF radio calibration with the 100 kHz crystal calibrator. This works fine as long as one is shooting for accuracy no better than one part in 10^4 (1.4 kHz on 20 meters for example). That is OK for 20m, but you will never net a 2 meter FM rig with measurements that crude! It may come as a surprise to some that the WWV carrier, as received in most locations, is not accurate to better than one part in 10^7 because of doppler shift in the skywave reflection from the ionosphere, which is constantly moving. The different techniques used to check zero-beat against the carrier degrade accuracy further; an audio beat for example is very poor, being no better than 10 Hz on a 10 MHz signal, or one part in 10^6, and usually worse. Some more exotic methods may introduce less error, but the ultimate limitation of the WWV signal itself still limits the accuracy to less than that needed to check a modern, state-of-the-art time base for a counter.

The 20 kHz VLF signal put out by WWVL is not subject to the doppler errors of the HF signals, and therefore is the frequency reference signal used by most laboratories requiring precise frequency calibrations. To use this signal, however, requires a VLF receiver and phase comparator, which is more equipment to build.

On Picking Frequency Tolerances

The reason for picking one part in 10^6 as being the minimum accuracy to shoot for in a counter design is that current VHF frequency tolerances (and VHF is where you *really* need a counter) require radios to be set to .0005%, or 5 parts in 10^6.

A device to measure this frequency must be significantly better than this, so one part in 10^6 is a worst case. As a related matter, the readout capability of the counter should be compatible with the accuracy of the instrument. In other words, a counter with an accuracy of one count out of one million (10^6) should have a six-digit readout. Any less than this, and the full capability of the counter is not being used. Any more, and the user is kidding himself by reading meaningless numbers. For instance, I could have built a nine-digit counter and thus be able to read 220 MHz to the nearest cycle, but this is better than one part in 10^8, and the last two digits would be unreliable. Something like "measuring with a micrometer and marking with chalk." This same rebuttal applies to those who argue that they don't like prescalers because they can't read the frequency to one cycle!

I chose to make the counter/time base and the counter in separate units, because I use the counter/time base as an accessory with my HF rig; that's where I want the clock and that's where the WWV receiver is, while the counter stays across the room at the work bench. The two units are connected by one coax cable. A builder could economize by putting both units in one cabinet to share a power supply, decoders, and readouts.

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ACTIVE FILTER DESIGN AND USE PART IV

In the previous parts of this series on active filters we have converted LC passive filters to active RC transistor filters and integrated circuit designs to active RC transistor filters and integrated circuit designs with external frequency compensation. Although all common types of filters were covered, design emphasis was placed on filters in the low or audio range of frequencies where bulky inductors tend to become both inefficient and unwieldy. However, the same principles can be applied to higher frequency filters and in this last part we will design a number of active filters in the high frequency range in addition to some circuits that should prove useful to the amateur.

As the frequency of interest rises, active filters utilizing RC networks tend to become progressively less efficient. In an attempt to maintain a satisfactory component value ratio, and still maintain reasonable Q, the resistors of the twin-T configuration are reduced in value only as much as necessary to allow the corresponding capacitors to fall in the low picofarad range. Such sacrifices reduce the usefulness of the twin-T above ultrasonic frequencies to relatively wide bandpass amplifiers and other requirements where bandwidth/attenuation values are not too low. Figure 1 shows a circuit designed around the RCA CA3035 linear integrated circuit amplifier and a twin-T network. At a frequency of 455 kHz, the component values of the network have dropped to a point where Q becomes a problem. However, the circuit is still useful as a buffer amplifier to follow a local oscillator stage, or give low attenuation over a medium range such as might be desired in the first i-f of a scanning receiver. Capacitors C5 and C6 act only as dc blocking capacitors. Varying R4 will provide a slight change in center frequency and Q The response of the circuit is shown in Fig. 2. Increasing the value of R1 will increase Q, but at the expense of gain. The curves of Fig. 2 show the response with both 120 kΩ and 270 kΩ resistors at R1.

In Fig. 3, a variation of the twin-T notch allows the active filter to be tuned over a 10:1 range. Resistor R1 again affects Q and

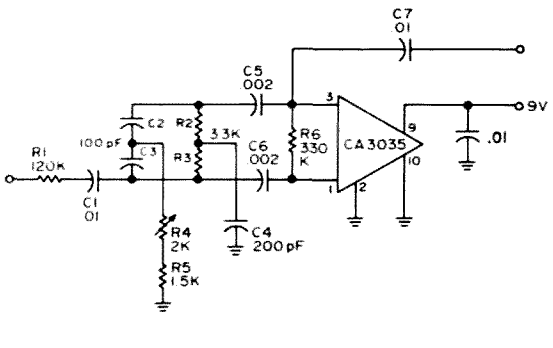


Fig. 1. 455 KHz bufferamp/filter.

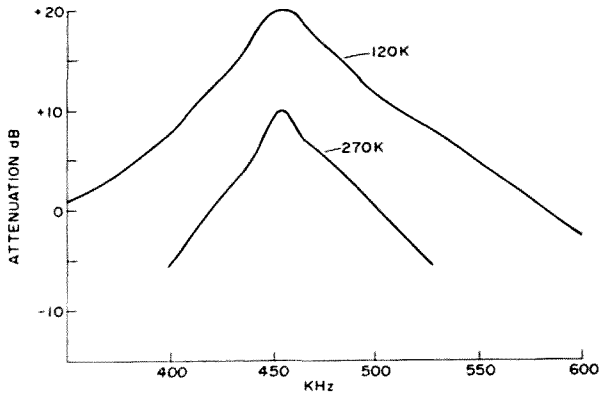


Fig. 2. 455 KHz bufferamp/filter response.

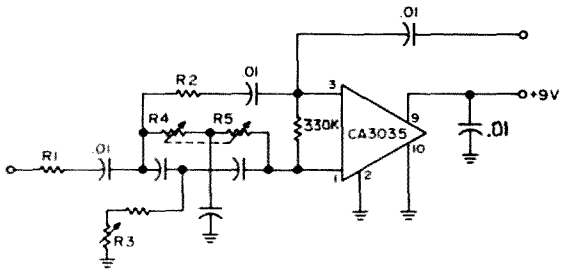


Fig. 3. Variable notch filter.

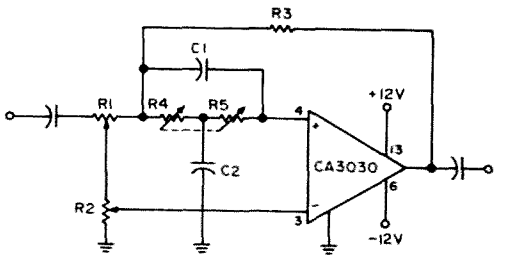


Fig. 4. Deep notch filter w/variable Q, frequency.

gain while R3 fine tunes Q. Ganged variable resistors R4 and R5 control the frequency of the notch while resistor R2 limits feedback.

Carrying the design of Fig. 3 further yields the configuration shown in Fig. 4. This deep notch filter may be varied in both Q and frequency. Using an operational amplifier as the active element allows differential operation of the amplifier to assure high attenuation of the notch frequency. The input signal is fed to the positive terminal, while a portion of the input signal combined with feedback from resistor R3 is fed to the negative input terminal. By adjusting R2 so that both inputs are equal, the output becomes zero, producing infinite attenuation at the notch frequency. This notch frequency can be varied over a 10:1 range by resistors R4 and R5. Varying resistor R1 alters the circuit Q allowing the width of the notch to be adjusted. Capacitors C1 and C2 are of the same value and may be determined by the formula for the capacitor bridge section of the twin-T net-

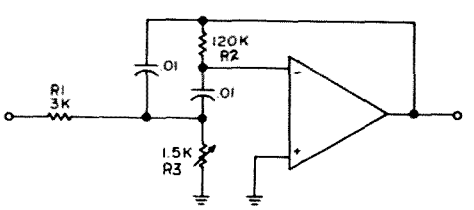


Fig. 5. Variable bandpass filter.

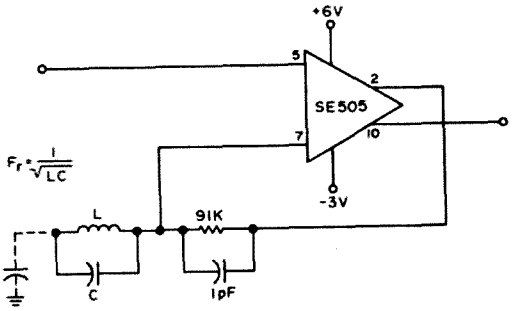


Fig. 6. Band reject amplifier.

work discussed in an earlier part of this series.

An active bandpass filter which can be varied in frequency, without affecting the bandwidth or gain, is shown in Fig. 5. The center frequency is controlled by resistor R3 while retaining a constant bandwidth of about 260 Hz. The component values shown will produce a bandpass response centering close to 2 kHz, with more than 26 dB gain. To design for a frequency of your choice, choose a convenient value for the capacitors, the desired gain and bandwidth, and plug these values into the following formulas:

$$R_1 = \frac{1}{2\pi BcGC}$$

$$R_2 = \frac{1}{\pi BwC}$$

$$R_3 = \sqrt{\frac{1}{2\pi C[(2f2/Bw) - BwG]}}$$

As with other active filters, this type may

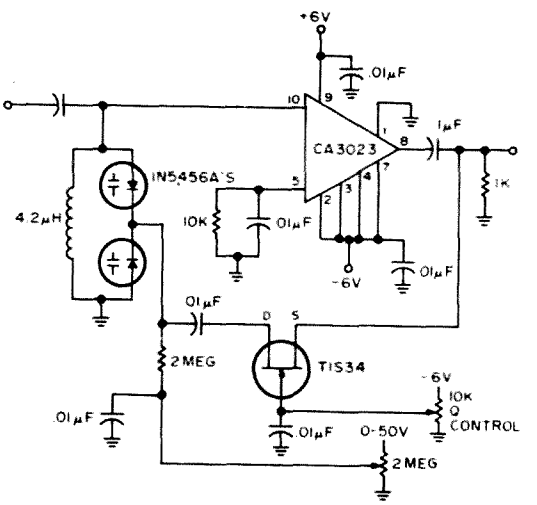


Fig. 7. Tunable i-f amplifier w/variable Q.

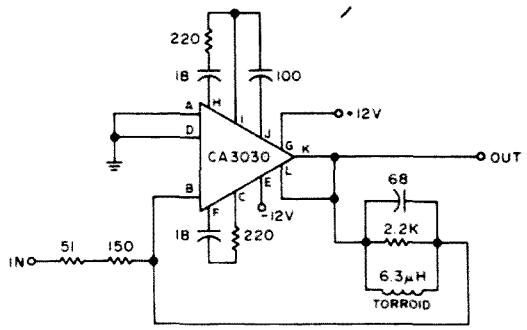


Fig. 8. 10 MHz bandpass amlifier.

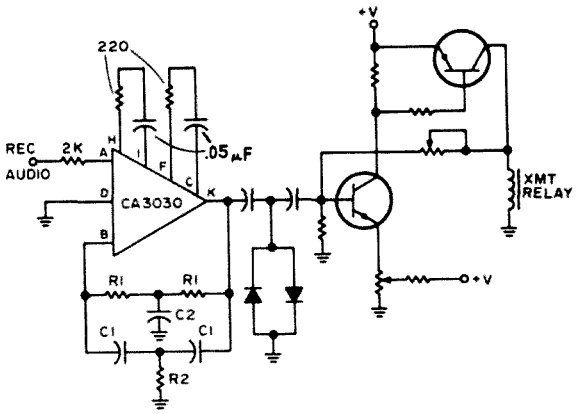


Fig. 10. Tone decoder filter.

also be cascaded and the individual filters tuned to different frequencies to provide a variable comb effect.

Active filters at radio frequencies require integrated circuits with the necessary frequency response and the return to inductors, although of a more convenient size. Figure 6 shows a band reject amplifier utilizing a Signetics differential amplifier. Good Q can be obtained, where wide response is not a requirement, by using torroid cores for winding the coils. By changing the position of C to that shown in the dashed line, the circuit becomes a bandpass amplifier. The Signetics integrated circuit has a bandwidth dependent upon power supply voltage, approximately 10 MHz for the voltages shown in Fig. 6, and may be pushed to 30 MHz with a maximum total voltage supply of 12 volts (+9 and -3 volts, etc.).

Every ham has, at one time or another, wished he could tune his receiver i-f off frequency slightly and/or increase i-f gain to get rid of interference. The novel circuit shown in Fig. 7 will do both, and when used with a high frequency integrated circuit, will provide a tunable rf amplifier. The values shown give a tunable response at about 10.7 MHz. The RCA CA3023 integrated circuit amplifier provides gain to 30 MHz. The field effect transistor acts as a variable resistance of the tuned circuit network and thus the input resistance of the amplifier. A change in the amount of feedback, or load resistance, will affect the Q of the tuned circuit. An increase in circuit Q of more than 2000 is possible while tuning control places the highest gain of the response at the desired frequency.

An RLC bandpass amplifier, utilizing the RCA CA3030 integrated circuit, is shown in Fig. 8. This amplifier will provide a gain of 20 dB at a center frequency of 10 MHz with a 3 dB response of about 1 MHz, as shown in Fig. 9. The effective Q of this circuit works out to be about 10.

Tone signaling and decoding circuitry can be greatly simplified by incorporating operational amplifiers as filter amplifiers. Use of the twin-T design is shown in Fig. 10. Values for the twin-T network are determined according to the following formulas:

$$R_1 = 2R2$$

$$C1 = \tfrac{1}{2}C_2$$

$$f_o = \frac{1}{2\pi R_1 C_1}$$

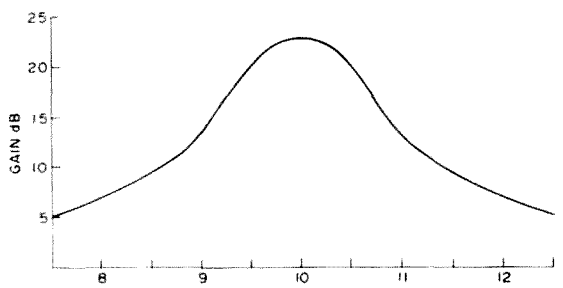


Fig. 9. 10 MHz bandpass response (w/o toroid).

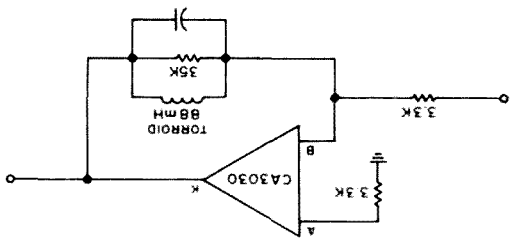


Fig. 11. LC circuit for tone decoder filter.

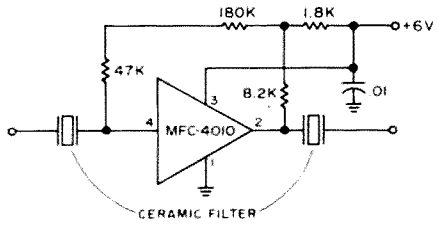


Fig. 12. 455 kHz i-f amplifier.

If you have a few 88 mH torroids in your parts box, the circuit of Fig. 11 can be used. This configuration shows the operational amplifier in an inverted mode, the only design which will produce a true single tuned response. Circuit Q here approaches 33 with a gain of more than 20 dB. In multiple frequency decoders, different tuned amplifiers may be paralleled with the necessary switching circuitry to provide coded entry into a repeater system.

Integrated circuits can also be used with ceramic or crystal elements as frequency components. The circuit of Fig. 12 gives 70 dB gain at a frequency of 455 kHz. Due to the fact that more gain is available from integrated circuits as compared to discrete components, impedances are easier to match without worrying about insertion loss or distorted responses.

Although single resonant circuits coupled with a linear or operational integrated circuit cannot be expected to provide narrow band responses at higher frequencies, they are useful as preamps or in other areas where a wider response curve can be used. Offering more than 20 dB gain, the circuit shown in Fig. 13 is designed for 20 meters where the 3 dB points of the response are less than

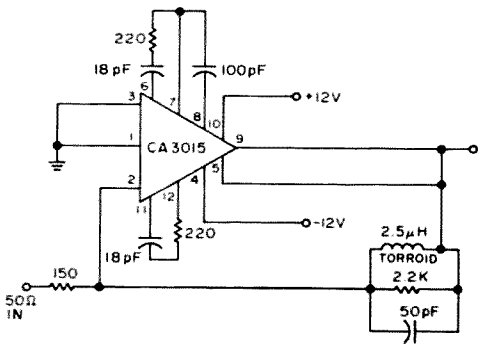


Fig. 13. 14 MHz amplifier.

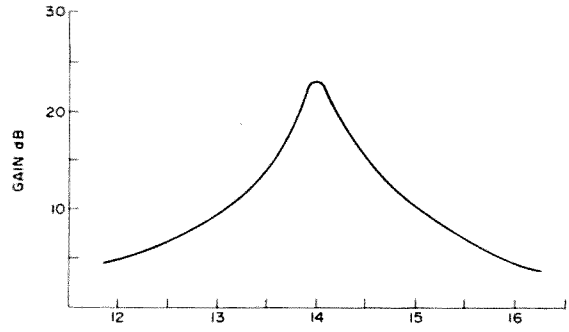


Fig. 14. Response curve of 14 MHz amplifier.

1 MHz wide. Figure 14 shows the response of the 14 MHz amplifier.

By the time you read this article, there will have been new advances in integrated circuit fabrication and design. However, the basic design methods will remain the same. We will probably see integrated circuits with greater available gain without the probability of feedback and possibly circuitry incorporating inductors and capacitors which can be changed in value by application of external control voltage.

For those interested in pursuing the subject of active filters further, I recommend, in addition to the article references, the newly published book *Active Inductorless Filters*, edited by Sanjit K. Mitra. It can be obtained through the IEEE, 345 E 47th Street, New York, NY 10017, at $7.50 for members and $9.95 for non-members.

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References

An IC Audio Notch Filter, John J. Schultz, W2EEY/1; *73* Magazine, July 1969.

Active Bandpass Filter With Adjustable Center Frequency and Constant Bandwidth, *Leslie* Robinson; *EEE*, February 1968.

FET's in RC Network Tune Active Filter, Arthur D. Delagrange; *Electronics*, December 7, 1970.

Variable Frequency and Q in a Notch Filter, Herman R. Gelbach; *EDN*, May 1968.

Signetics Corporation Application Note AN107, May 1966.

FET varies Q of Tuned Circuit by Several Thousand, Gary A. Vander Haagen; *Electronics*, September 1969.

Receiver Cirucits, *Popular Electronics Including Electronics World* February 1972.

Linear Integrated Circuits and MOS Devices, *RCA* Solid State Databook, *Series SSD-202 1972.*

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TRANSMISSION-LIMIT TIMER for REPEATERS

The ARRL won't be issuing Ragchew certificates to your repeater users, but then you won't be replacing finals every other day either.

A repeater should think for itself! It makes sense if you really consider it. The thing sits by itself all day every day (and night, too), spewing out whatever anyone wants to put into it. The only brain it has is the one owned by the body who sits at the business end of a control link. How much of a relief it would be to the control operator if the repeater itself could do most of the active monitoring – reducing his duty to not much more than keeping an ear tuned for dirty words.

The kind of brain every repeater really needs is actually quite simple. Primarily, it must limit the length of the repeater transmitter's "on" time. When a relay gets stuck shut, the "brain" would sense the problem and cut off the transmitter. When the local clown decides to play music through your system, or send endless Teletype signals through it, he won't be able to do it for long because the "brain" will know, and it will shut the repeater down for the duration of the attack. When a mobile operator sets his mike down on the seat and sits on the push-to-talk switch (it happens all the time!), the brain will put up with it for a minute or so – but if the anomaly persists, the brain cuts off the output of the big machine. When a long-winded operator ties up the repeater with another of his drawn-out ragchewing dissertations, you don't have to worry about hurting his feelings by telling him about it. Let the brain cut him out – automatically; he'll soon learn to keep his transmissions short, giving others a chance to use that fantastic communications system up there on the hill .

The Circuit

The timer circuit shown in Fig. 1 is the brain; it's ideal for just about all your repeater's timed operations because it is highly reliable on the one hand, and it is adjustable over a very broad period range on

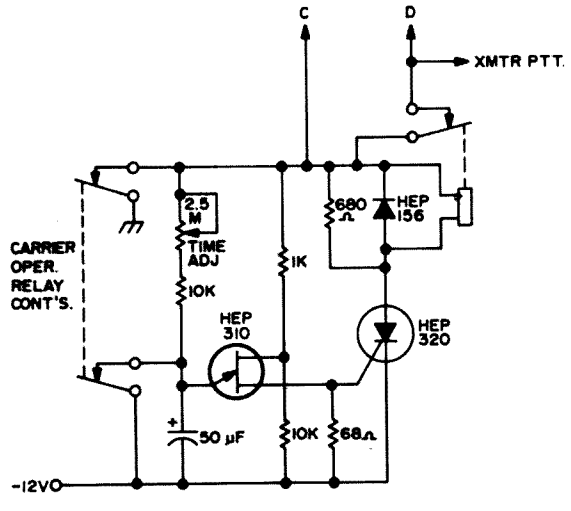


Fig. 1. This timer circuit is ideal for repeater applications because its period can be adjusted to any duration from 2 seconds to 4½ minutes. The top set of COR contracts starts the timed sequence and the lower set, on closing, resets the circuit. The relay is a Potter-Brumfield RS5D with a 6V coil having a resistance of 335Ω. Other relays can be used but the coil resistance must be no lower than that of the RS5D.

the other. It can be set for a period as short as 2 seconds, or as long as 4½ minutes. For a transmission-limit device, you'll probably want to set it for no more than 2 minutes at the most. It won't take the users long to cut their transmissions to less than that, you'll find.

The circuit shown employs a 6V dc relay with a coil resistance of 335Ω. Use of a relay with less resistance could cause excessive current, resulting in possible thermal destruction of semiconductors in the circuit. Just about any high-resistance relay will work in the circuit, though. The only precaution you should observe – other than that related to coil resistance – is to make sure that the relay contacts will be capable of handling the current load in the push-to-talk circuit. The contact rating of the RS5D is 2A; if your requirements exceed this value, the relay shown can be used to switch another relay with higher current-handling capability. Or, as an alternative, you can switch a circuit other than the push-to-talk line. The relay contacts, for example, can be used to remove B+ from the transmitter driver stages or the final amplifier. The idea, of course, is simply to get the transmitter off the air after the timed period.

When the relay is switched off, the coil's collapsing field will cause a very high voltage spike to be induced in the circuit – as most hams who have worked with semiconductors have learned in dismay. This spike can easily destroy many types of semiconductors; so avoid problems by placing the HEP 156 diode across the relay coil as shown. The diode provides a discharge path for voltage spikes, thus insuring against wipeout of your semiconductors. And be particularly careful not to get the diode installed backwards, too – or the circuit current will be shunted around the relay coil, creating another very real threat to semiconductor devices.

How It Works

When a signal appears at the receiver, the A set of contacts on the carrier-operated relay (Fig. 1) close and the B set opens, thus starting the timed operation. At the end of the period, if the COR contacts are still actuated by an incoming carrier, the P-B RS5D relay will put in, removing the push-to-talk signal from the repeater transmitter. As long as the carrier is on the channel after this point, the relay keeps the transmitter off the air. When the carrier finally drops out, though, the B set of contacts resets the timer and the A set removes the operational voltage. And the whole sequence is ready to begin anew.

Timer Defeat Circuit

If your repeater is subject to abuse from channel jokers, you might want to incorporate a separate reset system in your own UHF control link. This precludes the pos-

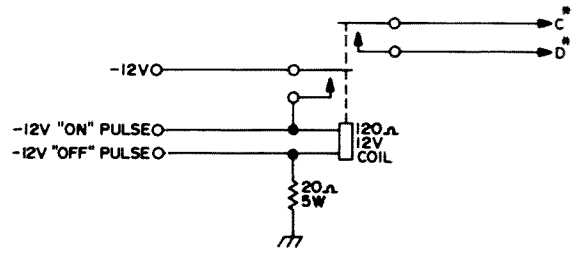


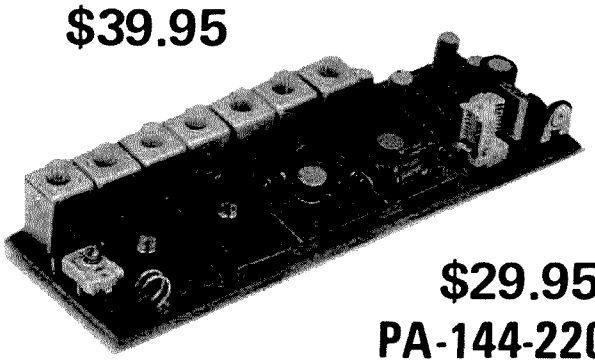
Fig. 2. Controlled timer "defeat" circuit. A momentary voltage pulse at the "on" point pulls in the relay and defeats the timer. A momentary pulse at "off" point returns the repeater to timed control.

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sibility of some clown placing an endless carrier on the repeater input frequency just to keep your repeater shut down.

Figure 2 shows one satisfactory method for bypassing the timer from the control point. The control contacts should be installed across points C and D of Fig. 1, as shown.

The resistor in the defeat circuit will act as a voltage-dropping device, so you have to select a value that will not reduce the voltage on the relay below its critical pull-in point. Most low-cost 12V dc relays will put in with 10V, though, so you can probably use that figure as a logical starting point. If the coil resistance of the relay is about 120Ω (current drain of 100 mA), you should use a resistor of about 20Ω. This cuts the voltage to just under 11V, which should easily give rapid pull-in.

When the "on" pulse actuates the relay, the lower set of contacts (Fig. 2) applies a constant voltage to the coil to keep the relay latched in its energized state. But when a −12V "off" pulse is applied at the coil-resistor terminal, the potential across the relay coil is cut to zero, since both coil terminals are being fed with the same voltage. However, for the brief period of the "off" pulse, the resistor must dissipate the full power of the 12V signal; therefore, the resistor should be of sufficient wattage to handle that high-power surge.

If the values are as shown in Fig. 2, the resistor will be dissipating just over 7W during application of the "off" pulse. A 5W resistor should easily handle that, though, considering the fact that the signal is only applied for perhaps a fraction of a second (depending on your individual control scheme, of course).

Semiconductors

The unijunction transistor, diode, and thyristor (SCR) are all Motorola devices . . . (Why not? The timer circuit itself was provided by Motorola's design engineers!) These devices are available from *Circuit Specialists, Inc., Box 3047, Scottsdale, Arizona.* The other goodies should come from your junkbox or the local electronics supplier. . . .K6MVH

EXTRA CLASS LICENSE STUDY GUIDE

Questions & Answers Part III

46. What is the vacuum tube counterpart of a (1) grounded base circuit; (2) grounded emitter circuit; (3) grounded collector circuit?

A. (1) the grounded-grid circuit; (2) the conventional grounded-cathode circuit; (3) the cathode follower.

47. What useful functions does a balanced modulator perform in a radio transmitter?

A. None, except in a SSB or DSB transmitter. The function of the balanced modulator is to simultaneously provide amplitude modulation and carrier suppression. In a DSB or SSB transmitter, it eliminates the carrier.

48. How does the directivity of an unterminated "V" antenna and parasitic beam antenna compare?

A. The unterminated "V" is bidirectional, with its major lobes extending in both directions along the line which bisects the angle of the "V." The parasitic beam is unidirectional, with its major lobe extending in the direction toward the director (away from the reflector). Both designs also have a number of minor lobes which are ignored in this discussion.

49. If a crystal lattice bandpass filter has bandwidths of 3 kc/s at the 60 dB points and 1.5 kc/s at the 6 dB points, calculate the shape factor. At what frequency is the best shape factor achieved in a crystal lattice filter?

A. "Shape factor" is defined only for two specific levels of attenuation; in this problem, the only shape factor which may be calculated is the 6–60 dB shape factor, which is 2.0 (3 kc/s divided by 1.5 kc/s, or the wider passband divided by the narrower).

50. What would happen if the grid-bias supply of a Class C modulated amplifier was suddenly short-circuited?

A. The results would depend upon the design of the modulated amplifier. If it followed good design practice and obtained a major portion of its operating bias from a grid leak, the effects might be unnoticeable. If all bias were obtained from the bias supply (which would be poor design in the first place, tending to produce poor modulation) the amplifier's plate and screen (if any) currents would soar, probably damaging the equipment. In between these extremes, output and efficiency would probably drop, and modulation suffer.

Of course, any protective fusing on the bias supply would let go – and in the absence of fuses, portions of the bias supply itself would probably be destroyed or severely damaged.

51. How do trimmer and padder capacitors affect the low and high frequencies in receiver tuning?

A. Trimmer capacitors establish the minimum capacitance in a circuit, and padders establish the maximum capacitance values. Thus the trimmer capacitors determine the highest frequency to which a circuit may be tuned, and the padders determine the lowest frequency. In normal receiver practice, the coil inductance is adjusted to establish the lowest frequency, and the padder capacitors are then used to "track" the oscillator and rf circuits (which must tune to frequencies separated by the i-f, and should maintain constant frequency separation at all points in the tuning range – an impossible task). Trimmer and padder adjustments interact rather seriously with each other, and the

proper procedure calls for adjustment of the low frequency portion of the range first, followed by adjustment at the higher frequencies, and touch-up of the lows. The process continues circularly in this fashion until operation is satisfactory at all points in the tuning range.

52. What is the phase relation between the input and output signals in the common-emitter, common-base, and common-collector transistor circuits?

A. In the common-emitter circuit, output signals are 180 degrees reversed in phase from input signals. In the other two configurations, output and input signals are in phase with each other.

53. How can a transmitter be tested for self oscillation? What precautions should be observed during testing?

A. The transmitter is tested for self oscillation by first operating each amplifier stage individually (in the absence of any driving signal) at normal operating levels, tuning all adjustments of each stage through their normal range, and determining that in the absence of input signals, no output signals are produced. The output stage should be tested first, followed by its driver, and so forth back to the stage immediately following the oscillator.

When each stage has been given a clean bill of health operated alone, they should be coupled to each other, again starting at the output end of the chain. Only when the entire amplifier chain can be operated at normal operating conditions without output in the absence of input can the transmitter be determined to be oscillation-free.

Output may be detected by means of an rf voltmeter connected to the antenna terminal, or by observing grid current in each stage (any grid current under these conditions usually indicates oscillation is occurring).

It may prove necessary to operate at reduced input voltages, and to supply bias voltage to keep power dissipation within limits. This is particularly true of grid-leak-biased stages; without input signal, they have no operating bias.

A transmitter undergoing such testing should never be connected to an antenna; a well-shielded dummy load is necessary.

54. How can unwanted VHF resonances in a transmitter amplifier be moved from TV channel frequencies?

A. VHF resonances within an HF transmitter are due to stray capacitance of circuit elements resonating with the self-inductance of connecting leads, both internal and external. The resonances can be shifted in frequency by changing either the capacitance of the inductance, or both. Capacitance can be increased by moving leads closer to the ground plane (chassis, in most cases), or decreased by moving leads farther from the ground plane. Inductance can be changed by changing the length of leads. Substitution of different types of components which are electrically equivalent at the normal operating frequency is a frequency cure; disc ceramic capacitors, for instance, usually have much less inductance than do equal-valued micas, and so move the parasitic resonances much higher in the spectrum.

Before attempting any of these cures, however, the specific part or parts contributing to the unwanted resonance must be identified, by careful probing with a grid-dip oscillator. When it is located, its nature usually gives good hints as to the means of moving the resonant frequency.

55. A 70 ohm transmission line is connected to a 35 ohm antenna. Calculate the standing wave ratio (SWR), the reflection coefficient, and the percent reflected power. If 10 amperes are flowing in the antenna terminals, what is the current in a transmission line node? How is the SWR related to the forward and reverse current flow?

A. When both the line impedance and load impedance are known, the VSWR is found most readily by dividing the lesser into the larger. In this case, it is 70/35, or 2.0.

With VSWR known, the reflection coefficient is calculated by the formula k = (VSWR − 1/(VSWR + 1), which gives us (2−1)(2+1) or 1/3.

Reflected power equals the square of the reflection coefficient, which would be 1/3 times 1/3 or 1/9, and this fraction, expressed as a percentage, is 11.111% (you can carry the string of "1's" out as far as you like).

Assuming that line losses are negligible

(an assumption which is frequently false, in practice), the current at each node along the line will be equal to VSWR divided by current in the load (where the load impedance is higher than the line impedance, it would be reversed, to be VSWR *times* load current), so in this problem it would be 5 amperes.

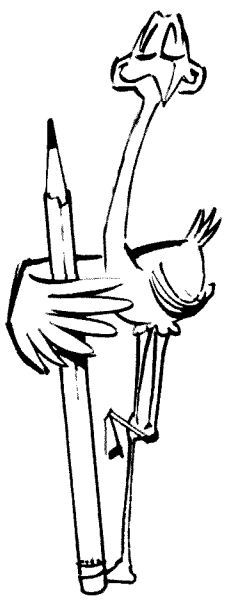
Finally, VSWR is defined as the ratio of peak voltage to minimum voltage, or peak current to minimum current. This ratio is related to the forward and reverse current flow by the reflection coefficient. Most present "SWR Meters" actually measure forward and reverse voltage, with the conversion to VSWR accomplished by a meter face which is calibrated by means of the reflection coefficient formula; this formula is algebraically manipulated to yield VSWR $= (1+K)/(1-K)$.

56. What is a grid-bias modulated amplifier? Should the source of fixed bias have a high or low internal resistance? Explain.

A. A grid-bias modulated amplifier is one in which the mixing or modulating action occurs in the grid circuit, rather than in the plate or screen circuits. Modulation is accomplished by superimposing the audio modulating voltage on the fixed bias of the amplifier stage, thus causing the instantaneous grid voltage to vary in step with the modulating signal. Grid-bias modulation is not limited to audio frequencies; it is the preferred method for video modulation of TV transmitters, because the modulation can be accomplished at a relatively low impedance level which permits large bandwidth. The bias source should have low internal resistance, because the grid current varies in a non-linear manner over the modulation cycle, and the flow of grid current through the bias source's internal resistance adds a distorting component to the modulating signal. By keeping the bias source impedance low, this distortion is minimized but not eliminated.

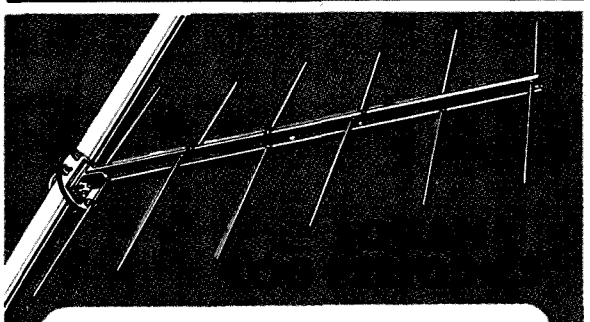
57. Of what importance is the signal-plus-noise ratio of a receiver? At what radio frequencies is this ratio most important?

A. The signal-plus-noise/noise ratio, usually called signal-to-noise ratio and abbreviated S/N ratio, sets an absolute floor to a receiver's sensitivity. Any signal which is



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appreciably weaker than the noise level is buried in the noise, and no amount of amplification can retrieve it because the noise is amplified as much as is the signal. The S/N ratio of a receiver becomes of extreme importance only at those frequencies where external noise is lower than the receiver's internal noise. This occurs near the upper limit of the HF range, somewhere between 15 and 50 MHz (depending upon the location of the receiver with respect to such external noise sources as automobiles, neon signs, and power lines). S/N ratio is always important at VHF and above, but is frequently expressed in terms of "noise figure" or "effective temperatuie." "Low-noise" amplifier circuits are intended to improve the S/N ratio of receivers in which they are used.

58. What are Aurora-reflected VHF signals? If such a signal is heard, what does it sound like?

A. Aurora-reflected signals are VHF signals which travel from transmitter to receiver by way of reflection from the ionized curtains of the aurora borealis ("Northern lights"). This propagation technique is used at frequencies of 50, 144, and sometimes 220 MHz for extended-range operation. Because the aurora curtains are always in rather rapid motion, the signals are distorted by doppler shifts of frequency; the distortion is usually so severe that voice modulation cannot be copied, and CW becomes the only usable modulation technique.

The tone of an aurora signal has been likened to the whine of a variable-speed power saw burning through a tough pine knot. It is a distinctly uncomfortable signal to copy, but aurora addicts burn the midnight oil in search of VHF DX by this means.

59. What is meant by percentage of modulation? What determines if a carrier wave is under- or over-modulated?

A. Percentage of modulation is a measure of the relative strength of sidebands and carrier wave, applicable only to AM signals in which the carrier is not suppressed, and the measurement is made by comparing the peak envelope voltage to the minimum envelope voltage over a single cycle of the modulating signal. A 100% modulated signal has no amplitude variations and so is effectively unmodulated.

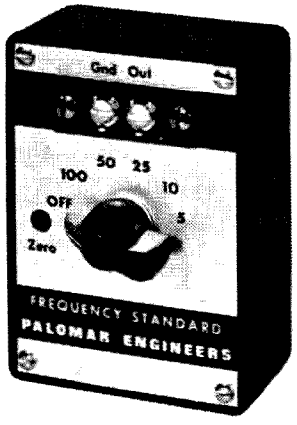
The factor determining under or over modulation of the carrier is the strength of the modulating signal in relation to that of the carrier. Another way of putting it is to say that it is determined by the relative amplitude of sidebands and carrier. "Selective fading" distortion can cause temporary overmodulation of a normal AM signal by attenuating the carrier without reducing sideband level, or undermodulation, by attenuating the sidebands and leaving the carrier strength untouched. For full modulation, the sidebands must be of such amplitude and phase relative to the carrier to produce an evelope in which the instantaneous voltage never falls below zero, and never rises above twice the unmodulated-carrier level.

60. How does a cathode-ray tube operate? What magnitude of voltage is normally used to bias the plates of a cathode-ray tube? What purpose does this magnitude of bias voltage serve?

A. A cathode-ray tube (CRT) consists of an electron gun, which includes a source of electrons in the form of a heated cathode together with electrodes which shape the electron emissions into a tight beam; deflection plates or coils which deflect the beam in both the horizontal and vertical directions; and a phosphorescent screen which glows with visible light wherever the electron beam strikes it. The focused beam is swept over the face of the screen by one set of deflection plates in a known pattern, and signals to be measured are applied to the other set of deflection plates. The resulting visible display on the screen provides the desired information about the signals under test.

The bias voltage on the plates of a CRT is normally several kilovolts more positive than is the cathode voltage. In addition, the deflection plates are biased from 10 to 100 volts with respect to the beam itself. The deflection plate bias is used to position the beam where desired on the screen, by attracting or repelling the electrons in the beam. The high voltage across the beam is necessary to provide sufficient energy in the beam in order to achieve satisfactory bright-

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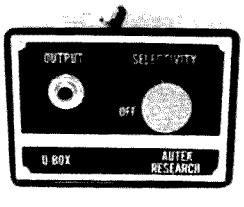
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ness of the trace. Some TV sets use acceleration voltages as high as 50,000 (but at only microamperes of current).

61. What are some causes of the excessive production of harmonics in rf amplifiers? How can these causes be remedied?

A. Excessive production of harmonics in rf amplifiers usually results from one or more of three basic causes: the amplifier is overbiased, overdriven, or has insufficient selectivity to reject the harmonics which are a necessary part of Class C amplification.

To remedy the causes, modification of the design is often necessary. No more bias should be used on each stage than is necessary to achieve reasonable efficiency, and no more drive should be applied than is necessary to reach saturation during the signal cycle. Selectivity can be increased by increasing the loaded Q of both input and output tank circuits; this is most easily accomplished by reducing the inductance of the tuned circuit, and increasing capacitance to restore resonance. Reducing the inductance removes resistance more rapidly than it does inductance, thus raising circuit Q (especially since the actual load impedance remains constant).

If excessive harmonics persist after all these remedies have been applied, additional tuned circuits can be added between stages, or at the amplifier output terminals, to aid in their rejection.

Excessive harmonics normally are a problem only with Class C amplifiers; linear amplifiers must be free of distortion, which implies almost total lack of harmonics in their output.

62. What effect does a transmission line which is not properly terminated have on the plate tank circuit of a transmitter?

A. The effect of an improperly terminated transmission line on the plate tank circuit of a transmitter depends almost entirely on the length of the transmission line (both its absolute length, and its relative length in fractions of a wavelength).

If the line is extremely long and has moderate to high losses, the increase in line losses due to the high SWR which results from improper termination will effectively swamp out the reflected power, and at the transmitter end the line will appear to be

properly terminated, even if the actual termination is an open or short circuit. In this case, the effect will be nil.

If, however, the line is relatively short, the effects then depend upon the exact type of termination as well as the length of the line. If the line is any exact multiple of 1/2 wavelength long (electrical length as distinguished from physical length), the load seen by the transmitter will be the same as that existing at the load end of the line. If this load is highly reactive, it will detune the plate tank circuit, possibly so far out of its range that the circuit cannot be tuned at all. If it is resistive (including open and short circuits) the effect will be to alter the amount of power which is extracted from the circuit; the transmitter may load easily, or may "refuse to load" if the impedance is too high.

If the line is any exact odd multiple of 1/4 wavelength long, the impedance at the terminating end will be inverted at the transmitter end. The effects are similar to those of 1/2 wave line lengths, but opens are converted to shorts, low impedance to high impedance, capacitance to inductance, and vice versa in all cases.

For any other line lengths, the impedance at the transmitter end is virtually always reactive, causing tuning difficulties. The major exceptions are those in which the reactance introduced by the line length exactly cancels the reactance present in the improper termination, thus presenting a resistive load to the transmitter. Even in this case, loading difficulties may result.

In general, then, improper termination of the transmission line manifests itself at the final tank circuit as difficulties in either tuning or loading or both. However, in any specific instance a line with mildly improper termination and highly serendipitious length (that means extremely lucky) may tune and load more easily than a properly terminated one. This is the reasoning behind "pruning" of transmission lines to simplify loading problems – which in practice is frequently the most practical solution to them.

63. How are reactance tubes used?

A. In these days of voltage-variable semiconductor capacitors, as little as possible. The reactance tube is an ordinary pentode in a special circuit which causes it to vary its output reactance as a function of its grid voltage, and before simpler components became widely available, such circuits were used to produce frequency modulation by varying the tuning of an oscillator tank circuit, or phase modulation by varying the tuning of an amplifier. Modern designers prefer the voltage-variable capacitor, which is used in the same way but takes a much simpler circuit.

64. How do phasing condensers help stabilize crystal filter circuits?

A. Phasing capacitors perform two functions in crystal filter circuits. They stabilize the circuit by balancing out the capacitance of the crystal's electrodes, thus elminating any path for energy to pass around the crystal itself, and they permit tuning of a rejection notch across the filter's passband, by varying the loading upon the crystal and the phasing of the balancing energy slightly.

65. What means may be employed to measure low frequencies? High frequencies? VHF and UHF?

A. Provided a sufficiently well-equipped lab is available, almost any frequencies short of UHF may be measured by counting the individual cycles for a known period of time, using a gated counter. Such devices are, however, expensive. Most amateurs measure frequencies in the audio range by comparison with the known audio frequencies broadcast by WWV, and those in the rf range up to UHF by comparison to calibrated standards which are calibrated against WWV. The calibrated standards can be used to verify calibration of the station receiver, which can then be used to measure frequencies which fall between the harmonics of the standards.

At UHF, "lecher wires" are often used. These consist essentially of an open-circuited parallel-wire transmission line along which a sensing device can be moved. The VSWR of the line is high because of the open-circuit termination. The sensor is moved through two successive peak or null points and the distance between them accurately measured. This is 1/2 wavelength, which can then be converted to frequency.

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A 5/8 WAVELENGTH WEATHER BALLOON VERTICAL THAT WORKS!

The antenna described in the June, 1971 issue of *73 did* work, as verified by witnesses and dozens of FB signal reports. To determine *why* it worked, another weather balloon antenna was sent up on July 16. Viewing the antenna from the ground, the answer was in plain sight, for in the gentle breeze, the antenna was on a 20–25 degree slope most of the time. Guying lines were not used on the first antenna, but were suggested as a method of holding the balloon in wind. Hence, the antenna was not a true vertical, but a "sloping longwire" or Hertz. While obviously the transmitter's pi-network was affording a fair match to it, the SWR observed may have been a false reading.

False SWR readings were also noted by an O.T. when using tuners on the transmitter end with extremely long antennas of this type. His article, written twenty-five years ago, will prove to be most interesting reading.[1]

This time, shooting for 5/8 wavelength, which is optimum for the lowest angle radiation from a vertical, I measured off 83 ft of 22 gage enameled wire for operation on 40 meters. A size "E" (22 cu. ft) cylinder of helium, a helium regulator, and an 8 ft diameter weather balloon were acquired.[2]

Helium and regulators are available from your local welding supply house. You *buy* the contents of the helium cylinder; you

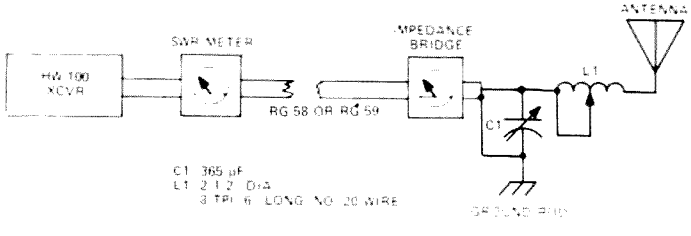


Fig. 1. The equipment setup used to match the 5/8 wavelength vertical. The impedance bridge is not necessary, but saves time by getting the coil tap "in the ball park" quickly. The matching network shown below gives an SWR of 1:1 on 40 meters.

rent the regulator, and put a deposit on it and the cylinder. The deposit is refundable when you return them.

The setup in Fig. 1 was then constructed. The impedance bridge is not necessary but saves time by getting your coil tap "in the ball park" quickly. The particular impedance bridge used here used a grid-dip oscillator for its operation, and thus operating the transmitter was not necessary. If using the impedance bridge in the ARRL handbook, tune up using just enough power to obtain a reading. Set the bridge to 50 ohms or 72 ohms, depending on whether you use RG-58 or RG-59 coax. Using just enough power for a reading on the impedance bridge, run the alligator clip up and down the coil to get a coarse dip on the meter. My coil tap was 4 turns from the antenna side. The 365 pF capacitor is then adjusted for lowest dip with the capacitor approximately half-open.

The impedance meter is then taken out of the circuit and the rig tuned up, again using just enough power to achieve an SWR reading. At this point the SWR read 3:1. This is because the impedance bridge can only read pure resistance accurately and the reactance of the matching network upsets it. A friend stationed in the yard adjusted the capacitor ever so slightly while I motioned through the window, and we had our 1:1 SWR!

We turned up on 40 CW and consecutively worked WB8GBK, WA5UGE, WB9FWJ and W5BYP, receiving 599 reports. Our last QSO was with W3EEK, who gave us a 589. Reason: a 3:1 SWR again.

We ran out back in the dark to find the weather balloon, still fully inflated, sitting on the ground. What brought it down? Dew! The kite string guy wires were soaked with it and quite heavy; for this reason, I recommend lightweight waterproof, floating, fly-fishing line.

With guy wires in place, the balloon vertical will perform satisfactorily on a relatively calm day. However, in stronger winds, the balloon will buffet downward, causing the antenna to become slack and even to touch the ground. For greater reliability, more lift is needed, and hence, more helium. As helium is quite expensive,

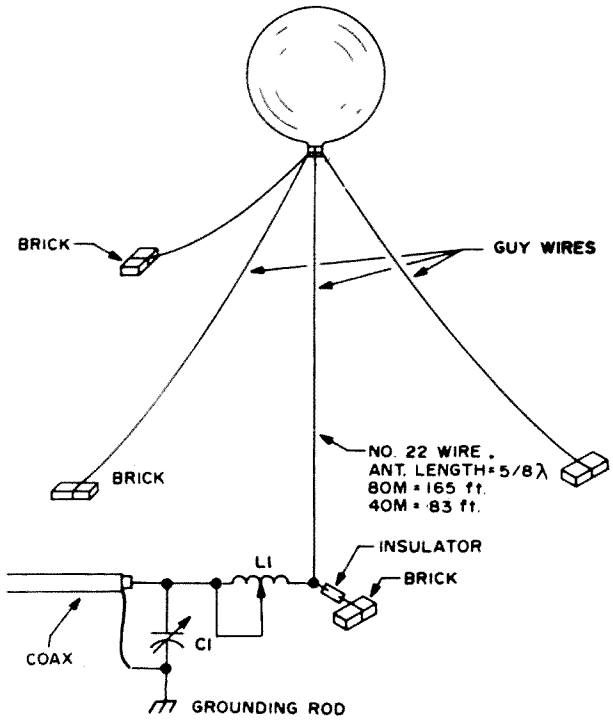


Fig. 2. The 5/8 wavelength weather balloon vertical with base matching network. No ground radials were used, although they could be added to improve performance. C1 – 365 pF receiving type variable; L1 – 2½" dia., 8 T.P.I., 6" long; 40M – 4 turns used.

the alternative then is hydrogen gas. Hydrogen cylinders and regulators are available, but as the cylinder is under great pressure, its use is quite dangerous. A safe alternative is the hydrogen generator kit offered by Fair Radio Sales, which uses lithium hydride in a steel cylinder, and is operated by immersion in water. The firm also sells a balloon inflating tube for use with the cylinder. As their price for the kit is cheaper than a size "E" cylinder of helium (22 cu. ft) and gives more gas volume (approximately 44 cu. ft), it should definitely be explored first, before purchasing helium.[3]

Good luck and good flying! Comments will be appreciated; enclose a stamp.

. . .K4EPI

1. George Bonadio, "The Balloon Antenna Flies Again," *QST* March, 1947.
2. Eight foot balloon, stock No. 60568, available from Edmund Scientific Co., Barrington, N.J. 08007. $2.00 postpaid.
3. Fair Radio Sales Co., 1016 E. Eureka St., Lima, Ohio 45802. Catalog No. 71, page 31, Hydrogen Generator Kit, #M-315 $6.95. Balloon Inflating Tube, #M-315 $1.50. Shipping weight 8 lbs.

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Automatic identifiers are the rule now for repeaters and remote base systems, but often the seemingly complicated or expensive electronic ID machines lead many repeater owners to use crude mechanical contrivances. This article describes an ID'er that takes advantage of MSI integrated circuits to reduce cost and wiring effort. This unit was built from design to completion in one day, and cost less than ten dollars in surplus IC's. Without power supply, it is about the size of a transistor radio.

Circuit

Figure 1 shows the basis for the concept behind the simple design of this unit. The entire character generation hardware is simply a counter with the desired outputs decoded to key an oscillator. A counter is a device that takes a series of input pulses to a single input terminal and produces a single output at one of several output terminals in sequence with each input pulse. Figure 1 shows two counters and two decoders. Since the output from the counters is in binary coded

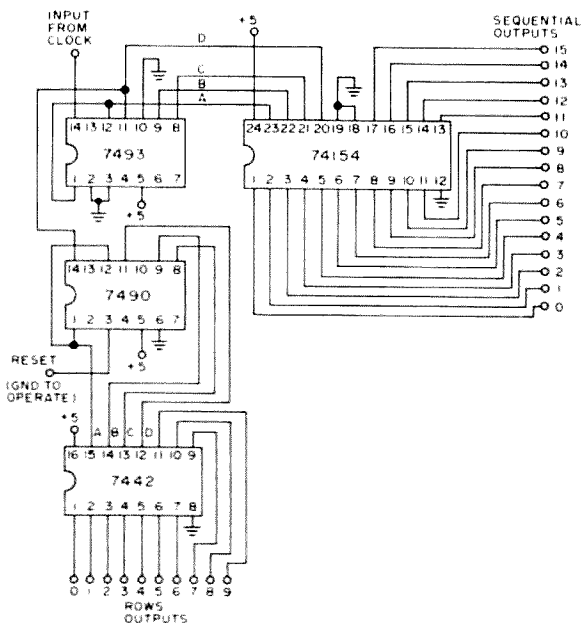
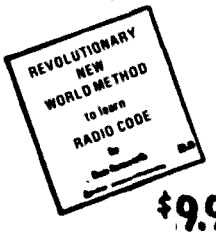


Fig. 1. Sequence generator.

decimal, or binary, a decoder is used to convert the four digit binary number from the counter to a one digit decimal number. The 7493 counter will produce 16 different

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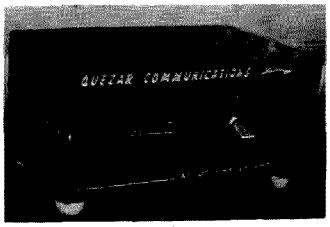
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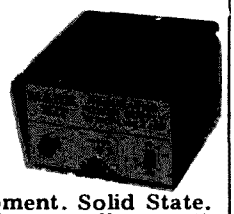


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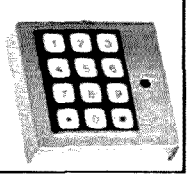
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output conditions for a series of input pulses, and the 7490 counter has ten. The drawing of Fig. 1, as with other drawings is an actual wiring diagram rather than a schematic. This will aid in construction and will simplify the description of what it does rather than how it does it. When the simple circuit of the counters and decoders is wired together and activated it can be seen that applying a pulse to the input of the 7493 will cause the output of the 74154 to change by one position. A bounceless pushbutton must be used for this demonstration. The high speed of the counter will show many outputs at one attempt to close or open mechanical contacts. Figure 7 shows a simple circuit that will change state on the first bounce and stay that way until the first bounce in the opposite direction. All but one of the 74154 output terminals will be high. When the pushbutton is pressed and released the low terminal will go high, and the next terminal in the sequence will go low. This is the basic concept of counting. The output of the 7490/7442 decade counting system will change every sixteen pushes of the button since it is connected to the output of the 7493 sixteen counter. This gives ten times sixteen, or 160 different possible states of the sequence generator.

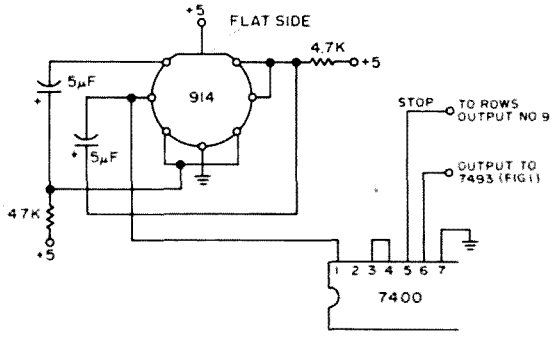
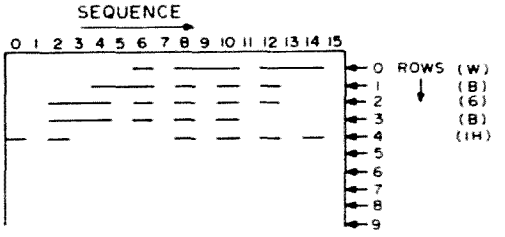


Fig. 2. Clock generator.

Figure 2 is an astable multivibrator that generates a square wave train of pulses to drive the counters. This is also a wiring diagram, but a bottom view. The multivibrator is made from an RTL dual gate μL914. RTL seems to work better in this application than TTL and a few 914's were available for this use. The 7400 is a quad two input gate used to "square up" the output of the 914, and to turn the output of the clock circuit

Table 1
Example for Encoding Character Sequence
WB6BIH



off when the 7442 has reached the next to the last position in its counting sequence. Releasing the reset line in Fig. 1 from ground will reset the 7490 to the first position in its count and start the clock pulses to the 7493. Regrounding the reset lead will allow the 7490 to count every sixteen clock pulses.

By now it is probably possible to anticipate how the ID will work. Table I illustrates how the counters generate the code characters. Each clock pulse represents a unit of time. A dit is one unit, a dah is three units, and the space between them is one unit. A space between letters is five units. The characters are generated horizontally by the output of the 74154, and when one sequence is completed the other counter switches to the next row. This could continue for 160 units, but the decade counter stops at the beginning of the last row, and when it is reset, it starts at the beginning of the first row, so there are only 144 units if the counter is stopped in this manner.

Figure 3 gives an example of how the code characters are selected from the counter output. Since the oscillator is to be keyed only for about half of the time, an eight input gate is about right for each row of sixteen time units. A 7430 is an eight input gate. If any input of the gate is grounded (goes low) the output will go high. This drawing gives the wiring diagram to show how the letters "W" and "B" are generated. In this case each 7430 generates one letter, but for a letter with a lot of dahs in it it may be necessary to use two 7430's for one row. In this case a 7404 inverter section could be used after each 7430, and then connected to the two inputs of a 7400 two input gate section. The outputs also

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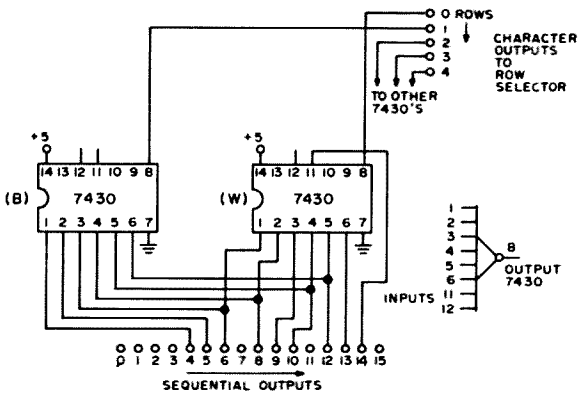


Fig. 3. Character selector wiring example for letters "W, B".

could be connected together simply with two diodes. In wiring up this character selector, a table such as Table I should be written and checked carefully. An error at this point can cause the rewiring of the entire character selector.

Figure 4 shows how the different rows of characters are selected. Both inputs of a 7400 gate must go high for the output to go low. The decade input from the 7442 goes low to select, so a 7404 inverter is used to make them go high. Since each 7430 output goes high, no inverter is needed. These two high going outputs are applied to a 7400 two input gate, one gate for each row. The outputs of the 7400 gates go low, so they are combined at the inputs of another 7430.

It can be seen from this that the number of 7430's, 7404's and 7400's will be determined by the length of message desired. Other information besides call signs may be

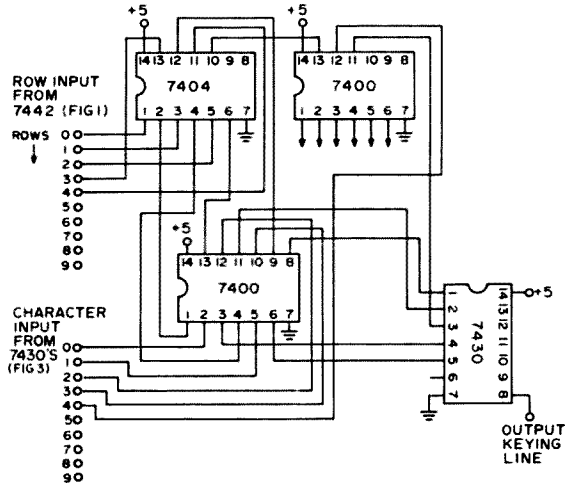


Fig. 4. Row selector.

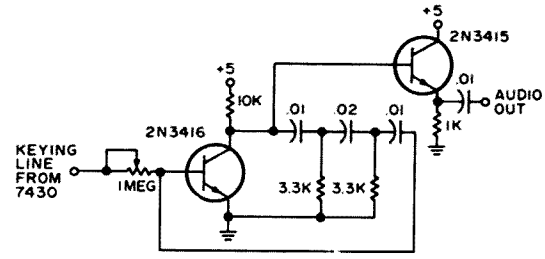


Fig. 5. Tone oscillator.

sent up to 144 units, or a 7493 and 74154 could be used in place of the 7490 and 7442 to increase the length of the message, at higher cost.

Figure 5 is a phase shift oscillator that was used with the ID'er. It is keyed by biasing the transistor on from the high output of the last 7430. The 1 meg pot is used to set bias on the transistor so that the collector voltage is about half of the B+ voltage. There will be beta variations between different transistors so the pot is needed to set bias exactly. It is difficult to get this oscillator to work reliably on five volts at higher audio frequencies because of the low voltage gain, so if higher B+ is available the frequency may be increased by making either the capacitors or resistors in the phase shift network smaller in value. The 2N3415 was added to minimize loading from the output that may prevent oscillation. RF from a nearby transmitter may prevent oscillation, so it may be necessary to shield the oscillator, and bypass and filter the leads to it.

Figure 6 shows a block diagram of the entire unit if there are any questions at this point.

Construction

The circuit can be built on a perforated

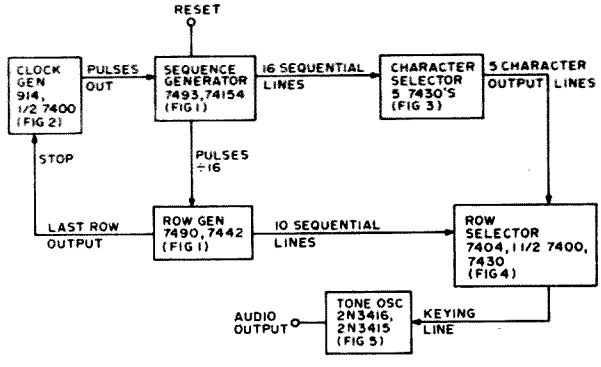


Fig. 6. Composite block diagram.

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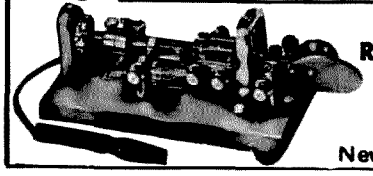
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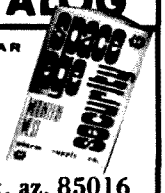
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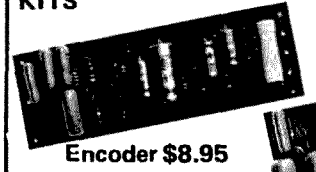
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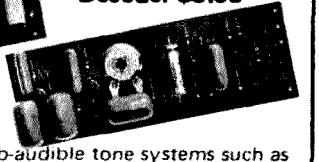
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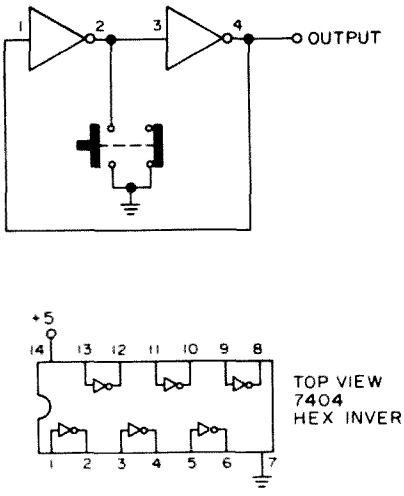


Fig. 7. Bounceless pushbutton.

board with holes that match the pins on the IC's. Small wire, solder soldering iron; and long patience are required. The wire ends can be inserted in the holes alongside the IC pin (in the same hole) and soldered. A desoldering tool of some type is helpful since molten solder often sticks in a blob between IC pins and is difficult to remove because of surface tension. The entire thing can be wired in one day, but it may seem like forever.

An LM 335 IC regulator makes an excellent component for a five volt, up to 900 mA power supply. A battery could be used for portable operation. Every HT needs an auto ID.

Results

This article described an automatic identifier that operates with digital precision and solid state reliability. The basic concept is simple to grasp, and the parts are inexpensive. The largest part of the story is told by the drawings, and data sheets obtained from the IC dealers will help the explanation. New or "surplus" IC advertisements at the back of this magazine offer low prices as well as information on the devices, so construction is not beyond someone inexperienced with logic. Since every repeater group must have someone with some electronic experience, there is little excuse for not having an all electronic ID. Perhaps this will eliminate some of the sloppy CW we hear every time 52.525 opens up!

. . .WB6BIH

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ADJUSTABLE TIME DELAY RELAY CIRCUIT

Any ham who has shopped around for a time delay relay knows they are hard to come by, particularly the adjustable type. Not only are they large but they are also relatively expensive. I have recently seen the vacuum type sealed relays advertised on the surplus market, but have never tried them, even though they were offered at ridiculously low prices, because the delay time was always some figure that didn't tie in with what I had in mind, such as 5 seconds or 5 minutes.

Several years ago I tried the following delay relay circuit, and have used it since. It has given absolutely no trouble, and I still have the original 6AL5 tube in service. It was a used one that had been in a TV set for several years before I junked it out.

As you well know, it takes time for the heaters of indirectly heated cathodes to raise the emitting surface of the cathode to a temperature high enough to start conduction in the tube. Set manufacturers have spent considerable time and money to overcome this nuisance of delay time from the instant the set is turned on to the instant a picture or sound appears. Several "instant on" TV sets have appeared on the market in recent years.

However, it is this "nuisance" that can be put to good use in a time delay circuit. Normally, with rated filament voltage applied, it will take from 10 to 15 seconds for the heater of a vacuum tube to raise the cathode to emitting temperature. We can increase this delay time if we decrease the applied filament voltage. By putting a variable rheostat in one leg of the filament circuit, and a sensitive relay in either the cathode circuit or the plate circuit, we have an adjustable time delay relay. And sensitive relays are available in plentiful supply on the surplus market at give-away prices. My latest flyer from Polypaks lists a SPDT 6500Ω coil, 2 μA relay at 2 for a dollar. This is a fraction of their original cost and a small fraction of the cost of an adjustable time delay relay. A 7-pin miniature socket and a used 6AL5 tube and a 20–50Ω wire wound pot shouldn't be too expensive to obtain, if

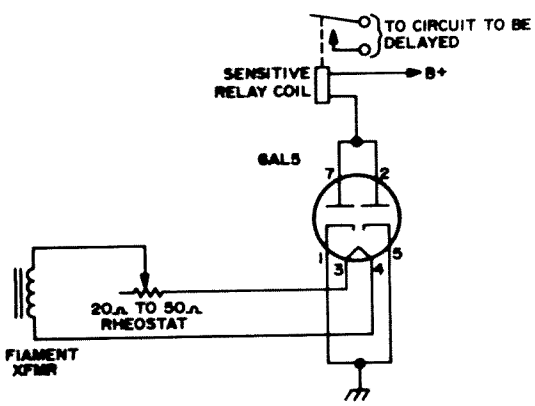
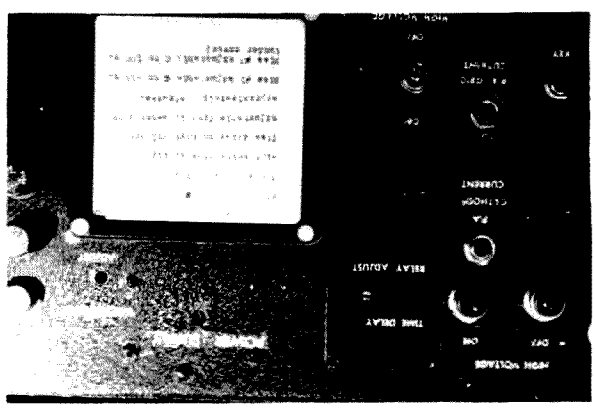


Fig. 1. The basic circuit for the time delay relay.



Neat external appearance of relay adjustment screw.

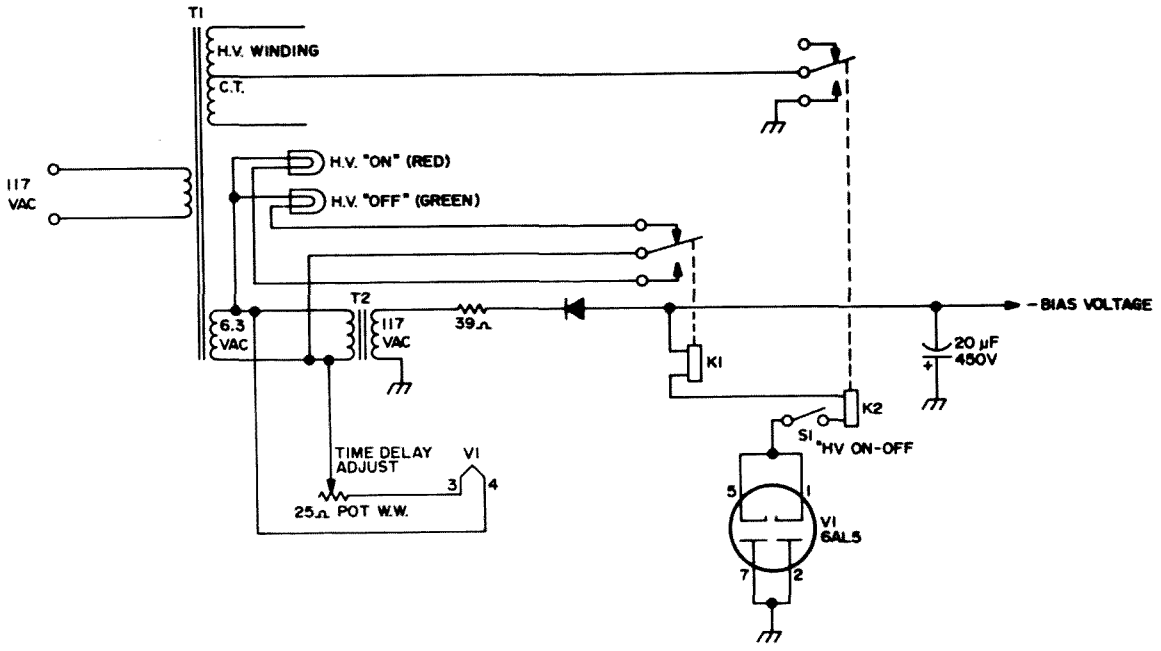
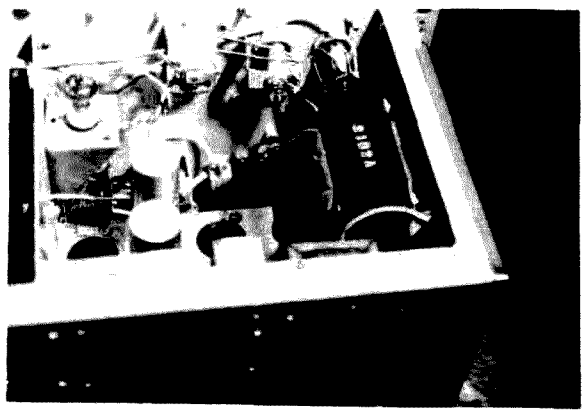


Fig. 2. The time delay relay as used in a power supply.

you don't already have them lying around. The filament source can porbably be found or "borrowed" from existing power supplies in the transmitter or receiver, as can the B plus needed. Figure 1 illustrates the basic circuit.

Figure 2 illustrates how I used this idea in one power supply that I built. T2 is a 6.3V filament transformer, back-connected to a 6.3V winding of transformer T1. This circuit supplies negative bias voltage for the buffer and final stages, through a resistor network and regulator tubes (not shown). I used two sensitive relays, although one relay could have been used if it were the DPDT type. In this case, relay 1 serves no really useful purpose except to "pretty-up" the front panel by turning red and green panel lights on and off. SW 1 opens up the relay circuit so the high voltage can be turned off manually after the delay circuit closes. The 25Ω wire wound pot is listed as available at supply houses, and the value isn't critical. Twenty to 50Ω should do the trick as long as it has the capacity to handle 300 μA of current.



The delay circuit takes up very little space.

One word of caution. Don't check your stop watch by the delay time. With no resistance in the filament circuit, the delay time will vary from 10 to 15 secons; there seems to be that much variation in individual 6AL5s. As the resistance of the pot is increased, the delay time will be increased. Two minutes seems to be about the practical limit. Beyond that, the operation is very erratic, and sometimes the relays will take several minutes to close. I have mine set for about 30 seconds and clocked it several times, and it stays fairly steady at 30 to 35 seconds delay time.

As the photographs show, this installation takes up very little space in the power supply. I originally had 866 Jr's in this power supply, but have since replaced them with silicon diodes. I left the delay circuit in because I liked the idea of letting the final and buffer tubes warm up a little before hitting them with full plate voltage. And I liked the red and green lights.

. . .WØMQB

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PETITION TO THE FCC

This petition was originally submitted to the FCC on April 26, 1971. It was acknowledged only as "comments," not as a petition, and no further word has been received from the FCC to date.

Objections to FCC Proposal for Rulemaking Docket 19162.

1. Does nothing to stop U.S.A. CW interference to foreign amateur fone signals and resulting ill will.

2. Does practically nothing to improve the very poor occupancy of all amateur bands caused by overcrowding of fone sub-bands and excessive CW bandwidth.

3. Continues the inequities in privileges all in favor of CW vs SSB fone including; power and communication ranges, suballocation bandwidths, use of international frequencies, susceptibility to mutual interference, and discrimination under the FCC "Incentive Licensing."

4. Continues the coercion of an ex post facto regulation, "Incentive Licensing," under which General Class fone stations lost 50% of their already inadequate and crowded fone frequencies, with Advanced Class fone stations also losing frequencies. Docket 19162 would return only a token part of the revoked fone frequencies and does nothing to alleviate the overcrowding of U.S.A. fone sub-bands, where only the highest power fone stations are frequently able to operate, and as a result many amateurs have quit amateur radio in disgust.

5. In the 80 meter band, Extra and Advanced Class stations could use fone in only a small already crowded portion of the international communication frequencies. Most of Region 3, Russia and many other foreign countries still could not be contacted directly.

6. A piecemeal extension of only Extra and Advanced fone stations into a small portion of the international frequencies without clearing out the widespread and unnecessary CW interference from U.S.A. stations will only add more confusion and probably more ill will.

Points of Agreement with FCC Proposal Docket 19162

1. The direction is correct in allowing U.S.A. fone stations to operate in frequencies established for international amateur communications.

2. Reduction of the exclusive Extra Class CW segments from 25 KC to 10 KC is justified because of poor occupancy. But all U.S.A. CW including the Extra segment should be moved out of the inadequate and extremely crowded international frequencies 7.0 to 7.1 MC as explained later.

General Considerations for Amateur Band Suballocations

1. U.S.A. CW amateurs can operate throughout all bands, regardless of interference produced on amateur fone signals, foreign or domestic. U.S.A. fone stations are allowed only small fractions of the amateur bands under present FCC rules, and the fone sub-bands are greatly overcrowded while large portions of the U.S.A. amateur bands frequently have negligible occupancy.

2. In the face of already crowded fone segments and the accelerated growth of SSB fone communications throughout the amateur bands, FCC's "Incentive Licensing" regulation arbitrarily cut the crowded fone bands in half for the largest group of General Class stations. The Advanced Class stations also lost fone frequencies. Many amateurs gave up in disgust, others switched to CW with its undiminished privileges, and many were coerced into becoming technical and Morse code experts and passing the Extra Class exam, *in order to regain the fone frequencies which had been taken away under "Incentive Licensing."* But nothing of consequence had been taken away from General Class CW operators who can still contact all foreign countries directly in the international frequencies of all bands, even though they are less qualified technically and in code speed than Extra Class fone operators who cannot contact fone stations except with split frequencies on the 40 and 80 meter bands – and with U.S.A. CW interference on the weak foreign signals.

3. It is apparent that "Incentive Licensing" tends to: perpetuate the semi-obsolete CW mode and discriminate against fone, prevent almost all foreign fone contacts by General Class fone stations, overcrowds the fone bands so as to discourage fone operation except for highest power stations. Why were no sanctions placed on General Class CW operators if the purpose was to upgrade licenses? Why are FCC monitoring stations ignoring all CW interference to foreign and domestic fone signals? It seems obvious that the FCC Amateur Division has been and probably still is dominated by CW advocates.

4. Split frequency fone operation is required on the 40 and 80 meter bands because U.S.A. fone stations are not allowed by the FCC to transmit in the frequency ranges agreed upon for international communications. And foreign fone stations cannot operate in most cases in the U.S.A. fone frequencies because in the rest of the world the U.S.A. fone frequencies are allocated to high power broadcasting, commercial and jamming stations. Many of the high power signals are more audible to foreign amateurs than in the U.S.A. Thus it is almost impossible for a U.S.A. fone station to pick a frequency where it can be heard in a foreign country, and it is equally difficult for a foreign station to find a U.S.A. station in the strong commercial and broadcast interference of the present U.S.A. fone bands. Split frequency fone contacts are wasteful of frequency space and are especially bothered by unavoidable as well as deliberate interference at both ends.

5. SSB fone requires about 2000 cycles bandwidth and at least 100 times the 20 cycle bandwidth needed for typical CW signals. With proper receiver filters and assuming full power for each mode, the signal/noise is at least 20 dB better in CW vs SSB fone, equivalent to 100 times in

power. The International Regulations (694-2) state, "All stations shall radiate only as much power as is necessary to ensure a satisfactory service." The use of unnecessary power is also a factor in TVI. Since 1 KW is the maximum power allowed SSB fone it would seem proper to limit CW to the same communication range as SSB fone. Therefore, the maximum power for CW should be reduced to 10 watts. Furthermore, since there are fewer CW than fone signals on all amateur bands the CW sub-band should not exceed 1% of the total in each amateur band.

6. SSB fone signals are much more susceptible to CW interference in the 2000 cycle bandwidth than are CW signals requiring only 20 cycles bandwidth. With proper CW filters a CW operator is able to reject almost all interference such as other CW signals which would completely blot out an SSB fone signal. Rejection tuning controls have been tried in SSB fone receivers but experience shows that rejection of even a single strong CW signal is not possible without partial or complete loss of intelligibility of a weak fone signal. As many as 100 distinct CW signals could be selected within the 2000 cycle passband needed for SSB fone. It is imperative that SSB fone have the "right-of-way" over CW and the only practical way is to segregate U.S.A. CW stations into an equitable sub-band.

7. Because of crowded fone bands, SSB fone equipment has undergone intensive development, to optimize SSB communications and to reduce interference between fone signals. Many new SSB receivers, transmitters and especially transceivers are produced each year in ever increasing quantities and in several countries. On the other hand there has been little if any progress toward achieving the potentialities of CW communication, probably because of excessive power and bandwidth allowed CW, and the ability to reject most interference with simple audio filters under these favorable conditions. A receiver having optimum design for CW reception is not known to have been described in the literature, or to be available for sale to amateurs.

To stimulate the development and design of improved CW receivers and filters and to allow time for CW operators to update their equipment, compromise bandwidths and power are proposed for amateur CW stations on a temporary basis. Instead of 1% for a CW sub-band, a range of 8 to 15% is suggested in various bands for the reasons described, with a power limit of 100 watts. The CW power limit might be reconsidered in a future international meeting.

8. U.S.A. CW interference, usually between U.S.A. CW stations, is particularly bad in the 40 and 80 meter bands and effects fone contacts between foreign fone stations as well as between foreign and U.S.A. fone stations in crossband operation. Considering the small number of CW signals and the large unused frequencies in these bands there is absolutely no valid reason for CW stations to interfere with foreign fone signals. Again, the answer to CW interference is segregation into an equitable sub-band for all U.S.A. CW stations. Examples of CW interference on the 40 and 80 meter bands follow:

3.55–3.7 MC 9–12 GMT:
Japan, Australia, etc. fone.
3.7–3.8 MC 22–14 GMT:
Europe, Africa, Region 2 fone.
7.0–7.1 MC 22–14 GMT:
Regions 1, 3, most of 2 fone.
7.15–7.2 MC 22–14 GMT:
Region 2 fone.

W1AW (ARRL) teletype broadcasts regularly kill all foreign fone contacts on or near 7.095 MC. Daily CW nets on 3790 (W5's) regularly interfere with Canadian phone patch nets on the same frequency. A number of U.S.A. CW stations normally operate on top of strong Canadian fone stations in the 3.75 to 3.80 range and sometimes above 3.8 in the U.S.A. Extra Class fone sub-band. U.S.A. Novice CW stations also operate in the "Canadian" fone band in the range 3.725 to 3.750. As a direct result of the U.S.A. CW interference, Canadian fone stations have managed, however deliberately, to prevent U.S.A. fone stations above 3.8 MC from contacting weak foreign fone stations who attempt to operate just below 3.8 in the required split frequencies. The situation has persisted for several years with a small but well known group of VE3 fone stations, many with very strong signals which preclude reception of any weak foreign signals, even if no U.S.A. CW signals are present.

It makes no sense to add to the present mess of signals below 3.8 MC and below 7.1 MC by allowing Extra and Advanced U.S.A. fone stations to operate in the proposed (Docket 19162) small segments of the international frequencies without clearing out the compeltely unnecessary signals, the root cause for widespread ill will. A far better solution to the problem of international fone contacts for U.S.A. fone stations results from segregation of U.S.A. fone and CW signals into equitable sub-bands. General Class fone stations must be given the same rights to contact foreign fone stations in the international communication frequencies which General Class CW stations have enjoyed with foreign CW stations.

9 Amateur bands belong to all amateurs in all countries and efficient use of these bands requires maximum occupancy and maximum communications between all radio amateurs, eliminating unnecessary, irresponsible and deliberate sources of interference wherever possible, and establishing equitable sub-bands for non-compatible modes of transmission. The FCC and the U.S.A. must provide leadership in establishing sensible sub-allocations for U.S.A. radio amteurs.

Regarding the statements of certain Canadian groups, it is ridiculous that a VE3 fone station in Niagara Falls Ontario should be able to contact European fone stations directly in the international frequencies below 3.8 MC while a W2 in Niagara Falls, New York, cannot – even with an Extra Class ticket. There are just not enough frequencies available in the amateur bands so that the U.S.A. with over half of the world's amateurs should limit its fone bands to only Stateside contacts, while providing for exclusive use of all of the international frequencies by neighboring countries. This is clearly a violation of civil rights for the U.S.A. fone amateurs.

There is also no question of "domination" of the amateur bands by U.S.A. fone stations because propagation to the rest of the world at best occurs for only a few hours each day, if at all, for only a few days each month, and on most amateur bands for only a few years in each 11 year sun spot cycle. The unfortunate crowding of the U.S.A. fone bands with only strong signals able to compete might suggest "domination" of the entire band if the fone bands are expanded. Similar crowding of VE fone stations into a 10 KC fone band would justify a similar argument.

There are today Canadian, South American and other amateur stations having signals as strong as, if not stronger than most U.S.A. stations. Maximum power, so called, is no longer a perogative of U.S.A. amateurs, and enforcement of a power limit for transmitters is probably as lax in foreign countries as it is in the U.S.A.

There is no provision in the international agreements for exclusive use of amateur frequencies by one country at the expense of another. There are no national boundaries to divide the amateurs of one country from those in another country, except as determined by each country in its rules and regulations The answer to any possible crowding of Canadian fone stations should come from

Ottawa and not from the FCC. And the answer to crowding of U.S.A. fone stations is full usage of all amateur bands based on an equitable segregation of CW stations.

10. The proposed Suballocation Chart is simplified to CW and SSB fone modes of transmission. SSB fone includes any single sideband transmission. SSB fone includes any single sideband transmission, as of a slow scan TV picture. AM, (amplitude modulation), FM (frequency modulation) DSB (double sideband) and slow scan TV as an AM signal are all omitted because all tend to cause unnecessary interference and are wasteful of frequency space. A time limit of perhaps 2 years should be placed on these transmission modes with interim operation limited to the proposed Novice fone band.

There is little justification for exclusive Extra Class fone bands, or for becoming a Morse code expert in order to be able to contact certain foreign stations using fone, as on the 80 meter band. Since the Advanced and Extra Class exams are essentially equivalent except for the code test, the Extra and Advanced fone subbands are identical.

Similarly, Conditional licenses are assumed to be the same as General Class, although the reason for so many Conditional Licenses is not understood.

11. Lack of occupancy by the U.S.A. of the international amateur frequencies has invited takeover of these frequencies by unauthorized transmitters and eventual loss of these frequencies. Those in the FCC Amateur Division who oppose legitimate and obviously needed expansion of the U.S.A. fone bands should ponder these facts.

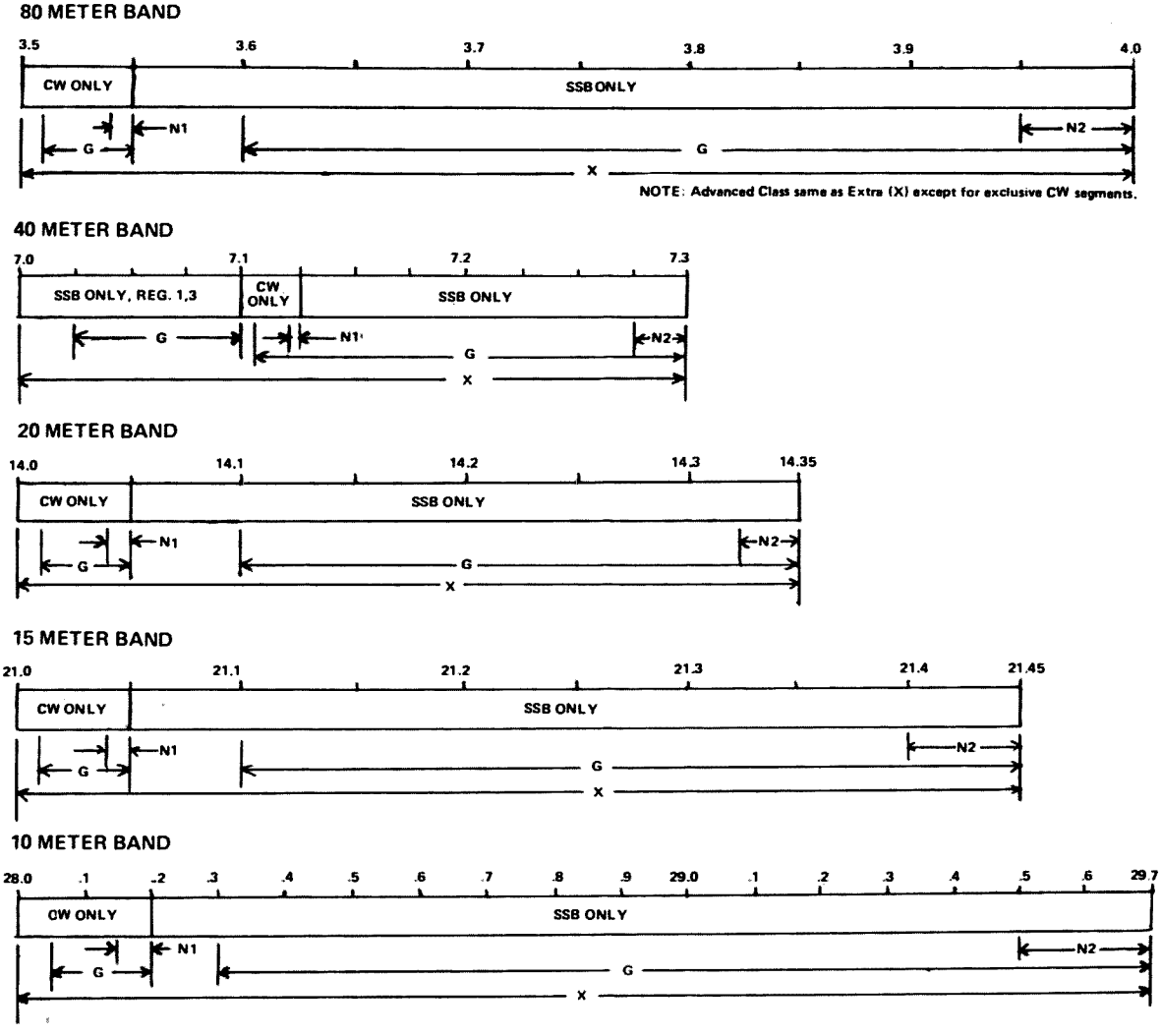
Specific Proposals for Amateur Band Suballocations

See chart

U.S.A. CW stations are segregated into an adequate "CW only" sub-band at the low end of the international frequency range 3.5 to 3.7 MC. An exclusive 10 KC segment for Extra Class CW, identical with the FCC proposal in Docket 19162, is included plus a 10 KC non-exclusive CW segment for Novices. The 50 KC CW sub-band has ten times the indicated bandwidth for an equitable division of the 80 meter band with U.S.A. SSB fone, as a temporary expedient and for the reasons described previously.

SSB fone has the remaining bandwidth with an exclusive 50 KC seg-

PROPOSED SUBALLOCATIONS FOR USA RADIO AMATEURS



ment for Extra and Advanced Class fone, and a non-exclusive 50 KC segment for Novice (N_2) licenses which are described later.

The proposed CW and SSB fone sub-band provide:

1. Elimination of U.S.A. CW interference on foreign and U.S.A. SSB fone signals.
2. Elimination of U.S.A. SSB fone interference on CW signals in the CW sub-band.
3. Maximum occupancy of the entire U.S.A. band.
4. All classes of U.S.A. SSB fone stations can contact all foreign fone stations directly.
5. General Class fone has four times the present bandwidth, with equal rights to contact foreign fone stations.
6. More U.S.A. fone stations should be able to operate with modest power, and antenna investment.
7. Attraction for many fone stations forced to stop operating because of "Incentive Licensing."
8. Reasonable incentive for upgrading licenses.
9. Provision Novice (N_2) SSB fone experience.
10. Fosters worldwide fone contacts and development of better equipment and antennas for 80 meters.
11. Stimulates improvement of CW equipment.
12. Anticipates optimum communications and maximum usage of this band during several years of minimum sun-spot activity.

Amateur Licensing Proposals

The exams for amateur radio licenses include technical and regulation questions which can usually be learned after reasonable study, plus the ability to transmit and receive Morse Code. Learning the code is difficult for most and especially for those who are only interested in fone communication.

The international regulations require that amateurs shall be able to send and receive Morse code but they do not require amateurs to become experts in Morse code before being able to make foreign contacts by voice. Instead of primary emphasis on Morse code it is suggested that operating proficiency and experience should be required at each step above the initial Novice license. This suggestion is based on the gradual obsolescence of the CW mode, the worldwide trend toward SSB fone, the vagueness of the old international regulations on code speed, the lack of code tests in some countries, and the growth of "amateur" activity in the citizen's band.

It is suggested that the present Novice Class be known as Novice (N_1), but with greater freedom in operating on all bands, although in a narrower frequency segment. Furthermore, tunable oscillators are suggested so as to permit contacts on the same frequency and to prevent obsolescence of special Novice transmitters. Still another reason is to permit a logical progression to Novice (N_2) SSB fone operation.

The Novice (N_2) exam might require that 25 QSL confirmations must be verified before the exam is taken, and verification might be made by a qualified amateur who would also conduct the exam in a manner of a Novice (N_1) exam. After passing the N_2 exam a Novice (N_2) license (or endorsement of the N_1 license) would permit operation in both CW and SSB fone Novice segments. However, before the General Class exam could be taken the Novice operator would have to receive QSL confirmations for at least 25 or 50 2 way SSB fone contacts. In this way all Novice operators would have to demonstrate operating proficiency in both CW and SSB fone before a higher grade license could be obtained.

Similar requirements for confirmations might be added for higher class licenses, for instance perhaps 100 countries for an Advanced, and 250 before an Extra Class exam could be taken.

It should be mandatory for U.S.A. amateurs to answer all legitimate requests for QSL cards, or have their licenses suspended, or even cancelled, when many complaints are received. QSL replies are as important as foreign contacts in fostering good will.

Exchange of QSL cards may be rather expensive, or quite slow when QSL Bureaus are used, for confirmation of foreign contacts. The U.S.A. exports many things for free, why not QSL cards?

40 Meter Band (7.0–7.3 MC)

All of the fone and CW amateur stations in Regions 1 and 3 have only a very restricted frequency range of 7.0 to 7.1 MC, and some countries in these regions allow only a small portion of this range. Additionally, most South American amateurs in Region 2, which can operate throughout the 7.0 to 7.3 MC range, prefer to operate below 7.1 so they can contact foreign stations directly, and to avoid the extremely strong broadcast, jamming, and commercial interference above 7.1 MC and extending to 7.3 MC. But U.S.A. CW stations usually in contact with other U.S.A. CW stations cause the greatest interference in the overcrowded international band 7.0 to 7.1 MC, and particularly with foreign fone signals. The CW interference causes widespread ill will and is inexcusable, and unnecessary, because CW operation including Novice CW normally operates on split frequency, whereas SSB fone normaliy uses transceivers which must operate on the same frequency.

It is proposed to provide a "CW only" sub-band at 7.10 to 7.125 MC with 5 KC segments for exclusive Extra Class and for non-exclusive Novice (N_1) CW. The 25 KC CW sub-band is consistent with the limited total bandwidth, and with the restrictions placed on SSB fone operation below 7.1 MC. It is also easier for CW to cope with broadcast and other interference because of its narrow bandwidth requirement.

To minimize U.S.A. fone interference in the crowded 7.0 to 7.1 MC range, it is also proposed to limit direct U.S.A. fone contacts to Region 1 and 3 fone stations, and within segments allowed each license class.

A 25 KC Novice (N_2) fone band is shown at the top end but otherwise there is no split-up of the fone range above 7.125 MC because of the heavy interferences mentioned above, and therefore the limited usefulness of the fone range above 7.125 MC. General Class fone would have five times the present fone bandwidth including Regions 1 and 3 under this proposal.

10, 15, and 20 Meter Bands

These three bands already have some capability for direct fone contacts with foreign countries, although the General Class fone bands are usually very crowded and fone operation is limited to a fraction of the total available bandwidth. The occupancy during periods of good propogation is relatively poor, particularly on the 10 meter band. It is suggested that this band be reduced to the range 28.0 to 28.5 with the same sub-bands as proposed for the 80 meter band.

The 15 meter band is nearly as wide as the 80 meter band and has about the same sub-bands for all modes and license classes as proposed for the 80 meter band.

The 20 meter band is particularly useful for long distance contacts throughout most of the sun spot cycle and also popular for contacts between U.S.A. stations. The 50 KC CW sub-band is relatively wider than on other bands while the proposed Novice fone band is only 25 KC wide. Both variations recognize the relatively greater present occupancy of the 20 meter band. Nevertheless, General Class fone would have 3-1/3 times the present bandwidth and the ability to contact all foreign fone stations directly.

. . .W9JT

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POWER LEAD FILTERS FOR 432

There is a particularly nasty form of trouble which can afflict solid state transmitters, and multi-rf stage receivers too, much more than the old fashioned tube jobs, and considerable attention must be paid in order to avoid it. This is interstage coupling through the low-impedance power lead connections and wires which ordinarily with tubes would not allow sufficient rf voltage to be sent from stage to stage to cause much trouble.

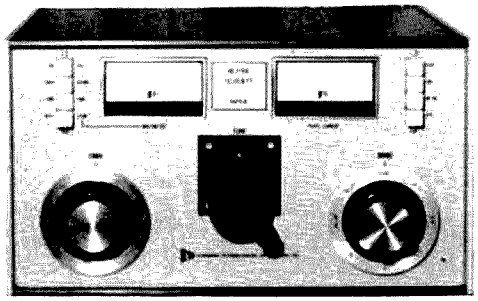
Even with tubes, precautions against this type of trouble had to be taken at times, especially as one went higher and higher in frequency up into UHF. One of the bad features about it is that it can happen easily enough between a first stage and a last stage, transforming one millivolt into one volt and causing violent reaction.

Very complicated power lead filters have been devised for this deal, as for example 8 and 16 section filters for an 8 tube radar i-f strip.

Ceramic feedthrough bypass capacitors were designed for use where power leads went through partitions, which cut down the nuisance rf voltage to a certain extent, enough for the tube type sources, exciters, and finals, if sufficient care and shielding was used in the overall design. Some of these ceramic feedthroughs work at 432 and some do not, as you will see.

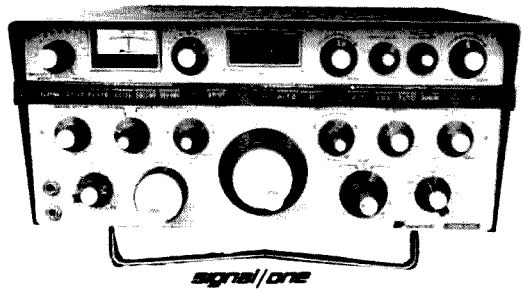
Now we are faced with devices (transistors) which exaggerate this kind of trouble due to very low rf impedances. Some transistor collector circuits operate with impedances of less than 10Ω, and for high power it may go under 1Ω. This means that a bypass that was good at 432 MHz with tubes, may let through rf voltage at low impedance, driven by those high current solid state devices to couple back from the

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★ Transceive or split frequency with two built in VFOs ★ CW keyer built in ★

★ IF shift – new patented QRM remover ★

★ IF noise blanker ★ Digital nixie frequency readout ★ superb computer grade construction by CMI

★ AFSK keyer ★ adjustable output power ★ broadband tuning ★ output wattmeter and reflected power meter ★ $2195

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final right past a "bypass" capacitor and into the exciter and knock it right out, subject to the phase involved. Or worse, throw the stages into self oscillation, because the input of these devices is also low and so operates on very small voltages of just the kind we're talking about. This is further aggravated if low cost devices are used in the first stages because then the low level operation is more subject to feedback.

Low cost in tubes was nothing. A 6CL6 for $1 had a Gm of over 10,000 and could deliver a watt or more as a 54 MHz crystal controlled oscillator. The same type would then double to 108 with several watts, and two $4.50 surplus 2C39's with Gm's of thirty to forty thousand brought you up to 432 with 5W.

Solid state devices are not quite up to that point as yet, unless money is no object and you order several dozen of the very latest at $200. Even with that kind of money, specs sometimes read like "two watts at 2GC" and then if you read the fine print or turn the page you'll find "gain of 4 dB."

Fortunately it's not quite that bad on 432 MHz, but say you've got a gain of 10 or 12 in each of two rf stages, the last one putting out one or two hundred milliwatts and you couple back just one percent along the battery leads to a triple stage with an output of only one or two milliwatts. You see what can happen? And it does, too! Not only that, but if it just happens to be in phase, you get output even when you pull the crystal out, and that is about the worst thing that can happen to any transmitter.

So it will pay to examine this question in detail, because as amateurs we have an obligation as well as the need to develop our skills in the art, and this subject is a basic one for all types of transmission and reception by solid state devices.

With this in mind, I started in on the power lead filter deal with the goal being a small low-cost unit easy to make, with at least 40 dB of attenuation in voltage, if possible. It turned out that it was.

These tests and the final low cost filters are good for receivers also. A contemporary author in a magazine I happened to be

reading recently mentioned, "You'll have an easier time with one rf stage than with two." No argument there at all. Just that these tests and filters should help reduce the effort needed to "tame" two rf receiver stages, as well as multi-stage transmitters.

How to Get "Cold" Connections

Most of our work on UHF calls for hot wires, that is, wires carrying plenty of rf, and losing the least amount possible through insulation losses, radiation, wire resistance, or by any other nuisance method. For power leads we want just the opposite, to carry dc and lose all the rf immediately. Or at least so much that you can neither detect it, nor find any nuisance effects, which amounts to the same thing. An oscillator and rf amplifier will do for the source and a tuned diode detector will do the job of measuring. After all, we're not doing a research job for a capacitor company, we're just interested in learning how to put a solid state transmitter on the air with a good stable signal without touchy feedback, connectors that jump rf-wise, and other transmitting plagues. The same holds for the multi-stage receiver also.

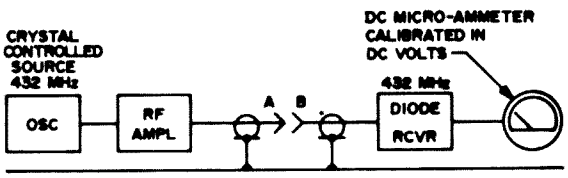


Fig. 1. Test setup, power lead filters.

Figure 1 shows a test setup that can tell us what's what in this matter. After all, if I do it and tell you about it, that gives you more time to build things and get them on the air.

At "A" we have a good 20 mW at 432 MHz coming onto the test plank. At "B" we have another cable going to the tuned diode detector, and with the units shown the meter reads 4V dc when "A" is connected to "B."

The trick is to connect "something" between A and B that will carry heavy current 12V dc with only a small drop or none at all. This may mean a thin wire choke, or a resistor for a low power first stage drawing only 10 or 20 mils and it may mean later on a heavy wire choke for 12V at ¼A for a 3W final.

Tests

Referring to Fig. 1, all results are given in dc volts at the output of the diode detector.

Coaxial cable A to B, 4V; piece of wire on the ground, 3.5; piece of wire with 1000 pF to ground at B, .3; 1000 pF at A, .29; 1000 pF at A and B, .04 (40 mW); 100Ω resistor between A and B, .042; with 1000 pF at A and B, plus 100Ω between A and B, 0V. This could be used with a low current stage like a receiver where even down to 6V is all right for low noise rf, but let's keep going. You certainly couldn't modulate a solid state final through a 100Ω resistor.

Choke coil between A and B, No. 40 wire, ¼ in. diameter, length ½ in., no capacitors, .2; with 1000 pF at A, .01V; with 100 at A and B, ½ mV. Beginning to look good.

Ten turns No. 34 wire, 20 mV, showing that the choke question is subject to variations in filter power, in this version.

Yellow surplus choke, 1/8 in. diameter, ¼ in. long, about 25 turns, 1 mV, good but not quite the ideal yet. Ten turns on the choke and 1000 dipped mica at A and B, 10 mV. Same, with small 3/16th Lafayette ceramics, 3 mV.

Homebrewed flat coax, as in Fig. 2, 10 mV; two 1000 pF at A and B, plus 20 turn choke, 1 mV. At this point I thought about a small module as in Fig. 2. The meter hit the pin. Bringing the two capacitors to *one*

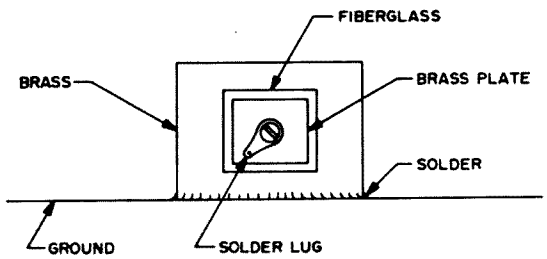


Fig. 2. Simulated, flat coaxial filter.

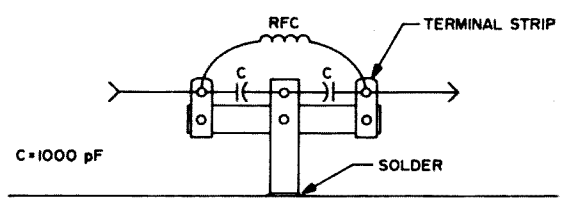
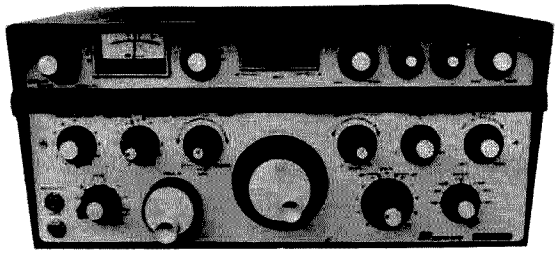


Fig. 3. Filter module.

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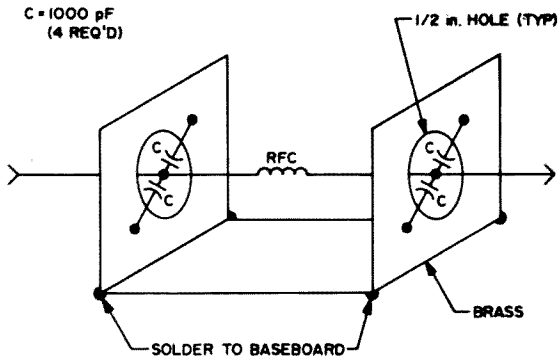


Fig. 4. Brass frame module.

connector, which had some inductance to ground, was absolutely no good.

I then cut out a small brass frame as in Fig. 4. Hurray! The first time to hit a real zero volts. It makes you haul out the ohmmeter and check for a short or an open! Same, but without choke, also zero.

I noticed that every time I checked with another 1000 pF on a little coffee stick from A or B to ground, in effect paralleling the one already there, the meter plunged to near zero. At 432 MHz this is the same thing you may have read about more than once in my writings. More than one capacitor at the same place. It parallels the inductance and drops it.

Now we're getting close to the ideal; in fact, to cut it short, Fig. 5 shows the ideal. No brass plate is needed, and you can use it either on the baseboard or with the choke resistor installed in a hole in a box wall, or what have you.

The two-section filter using 4 capacitors plus a choke in between, really does the job. You imagine the meter moves, maybe. There might be somewhere between 1/10th and 100th of a millivolt of rf leaking through, and some or all of this may be "jumping" through the air.

So now you can make up units in advance, as in Fig. 5, and be sure they'll work at 432 MHz.

30 pF Capacitors

Just for fun, another two-section filter was assembled, as in Fig. 5, but with the low value of 30 pF for each of the four capacitors. Of course at 432 MHz the rf impedance of 30 pF looks almost like a dead

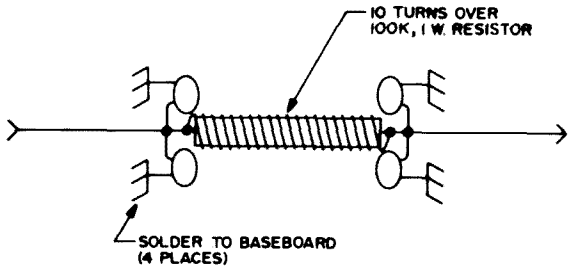


Fig. 5A. Ideal low-cost power lead filter, top view.

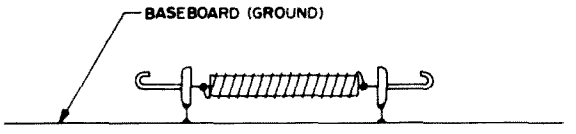


Fig. 5B. Side biew of power lead filter.

short, and it was. I could not tell the difference between the 150 pF filter and the 30 pF one. This makes it easy if you have large quantities of surplus dipped mica capacitors of odd values.

The reduction in rf voltage is something like 50 dB, dropping from 4V down to about one hundred thousandth of a volt. This is plenty for power lead filters. The cost in parts is that of four capacitors at around 10¢ each, and a resistor for a coil form.

"Boughten" Feed-through Capacitors

The first ones tried were disappointing. The type "FT," shown in Fig. 6 allowed 20 mV to leak through.

I did dig up a couple of good ones out of a 1946 surplus UHF Navy unit. I suspect that the price will be quite high on such units, if they can be found. These look like Fig. 7, and perhaps some reader from the sales department of Sprague or Centralab or

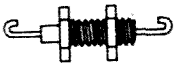


Fig. 6. Type "FT" feedthrough capacitor.

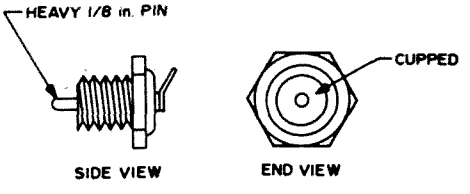
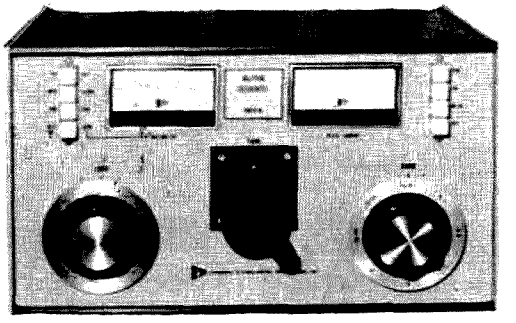


Fig. 7. Feedthrough capacitor.

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Erie can tell me what they are, and for how much to amateurs interested in good UHF feedthrough bypasses. They do seem to work as well as the final form shown in Fig. 5, so if you can find them, pay the price, and have a wall to put them in, such as in an enclosed rf stage, you can use them.

Subminiature Filters

The test setup of Fig. 1 being in operation, a smaller version was tried, to be ready for the size reduction being looked forward to with all kinds of new and exciting very small components becoming available on the market.

As long as 30 pF capacitors worked well, anything over that would naturally be all right, so with a tenth watt resistor for the choke coil form, away we went.

While this is not as small as can be made today, when you get into chips and hybrids, prices go in an inverse ratio. Little 1/8 in. x 1/8 in. x 1/16 in. square Lafayette ceramics cost around 13¢ so we still can call this one low cost.

The assembly is just the same as in Fig. 5, with the total space occupied being ½ x 5/8 x ¼ in., and, as mentioned, it could be cut down even more if you tried.

It worked just the same as the larger one in Fig. 5. Need I say more?

Checking Out the Filter

Figure 8 shows the results of tests conducted on a crystal-controlled exciter and rf final destined for use in the 432'er solid state assembly. Note the one volt of rf at test point D *without* the filter. At the same point, also without the filter, about a tenth of a volt was found with only the exciter fired up. See Fig. 9. You can see what that kind of rf path will do for feedback from a quarter watt or a one-half watt final.

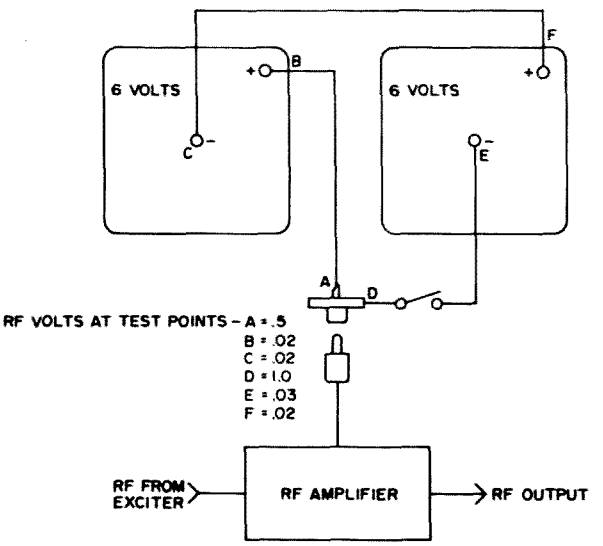


Fig. 8. Test results, rf on batteries and leads.

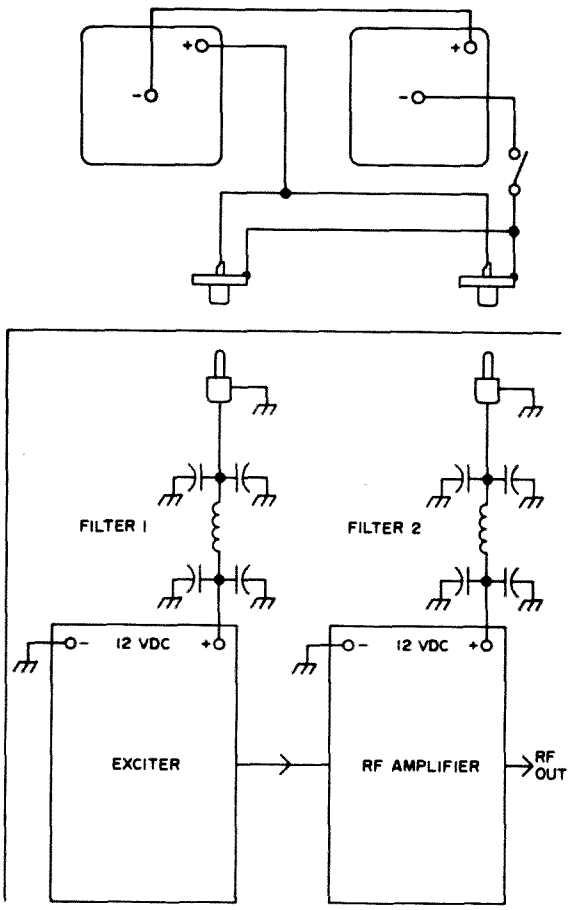


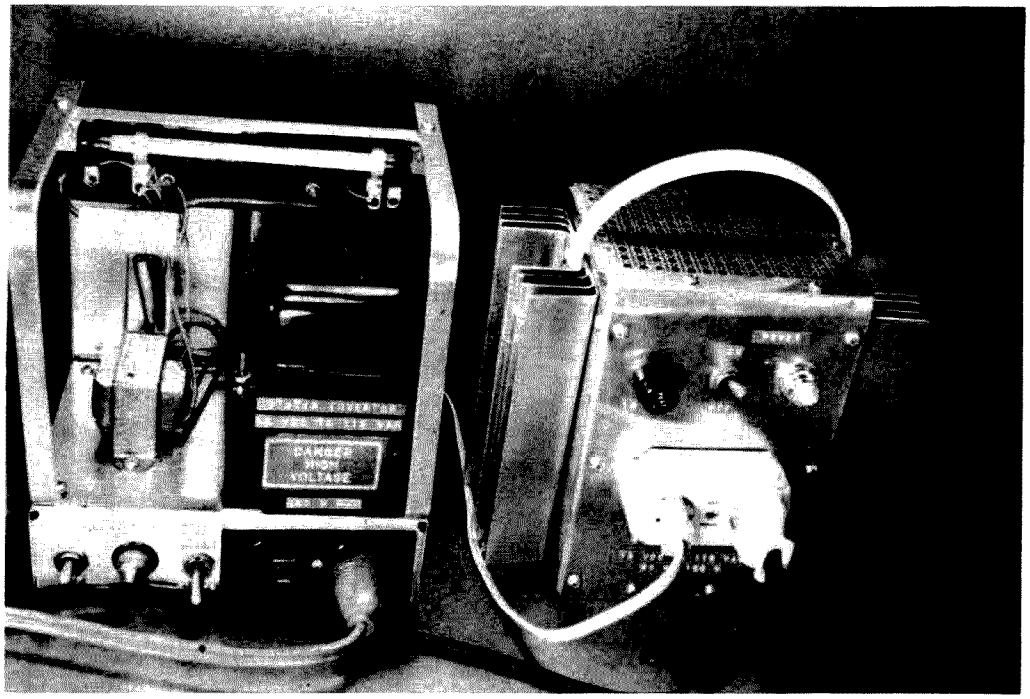
Fig. 9. Battery lead filters.

So a piece of copper-clad was put down under the two units as shown in Fig. 9 and the two filters installed. Perfect! No rf could be detected at all at any place on the batteries. Note that *two* filters are now present across any feedback path through the batteries and their leads.

There still exists possible voltage field and magnetic field feedback paths between the rf final and the exciter, but that's another story. The battery lead feedback path is not eliminated. And at least one thing shows up in favor for the solid state deives. There is only *one* wire in which to put a filter!

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Complete power system in operation. Unit B to the left – Unit A to the right.

PORTABLE HOUSE POWER

Adding a 12V dc to 110V ac 60 Hz static inverter to the equipment list of the amateur experimenter will increase the versatility of his station to a degree that makes any reasonable labor in this direction worth while. The two units, presented here, are intended to be used together and, with a 12V auto battery as primary power, have the necessary output capability to supply 110V ac 50–60 Hz to an entire 150W station, including the receiver. There are no communications equipment modifications required. Just plug the transmitter and receiver into their receptacles and turn on the inverter switches.

Unit A has an output of 90W and Unit B 200W. Both outputs are 50–60 Hz symmetrical square waves. It might be well to note at this point that the peak value of a 110V ac, rms, square wave is 110V, while the peak value of a 110V ac, rms, sine wave is 155V. This difference in peak values will not be noticed in resistive loads such as tube filaments, but will cause lower voltages in rectifier circuits that depend upon capacitor input filters and voltage doublers. The output frequency of Unit A is 50–60 Hz and is not affected by any type of load, resistive or transformer. When Unit B is in the slave mode, it is driven by a signal from the output of Unit A. The frequency will be the same as Unit A and will not be affected by loading. When operated in the master mode, it converts to an oscillator tuned to 60 Hz which

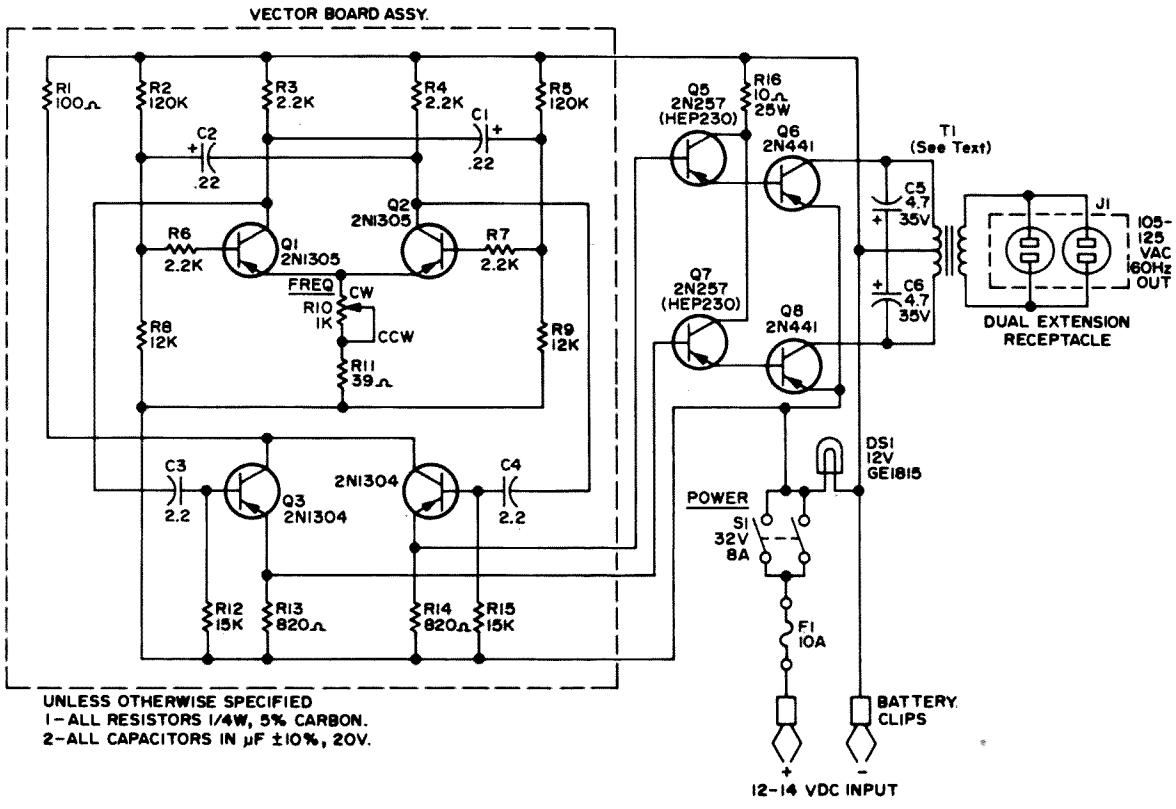


Fig. 1. Unit A inverter.

produces an output without external drive. It will maintain this frequency very well when providing power for resistive appliances, such as soldering irons and lamps, that require inputs within the range of 50 to 100W.

Both units make excellent projects for amateurs with an urge to use their oscilloscope and to gain experience with transistor power switches.

The fundamental problem in making our high power square wave is to switch the 12V dc from one side of a center-tapped transformer primary to the other at a predetermined rate. If the secondary has 10 times more turns than the primary, the output of this winding – neglecting losses – will be a 120V ac rms square wave. Using a transformer as a tuned circuit element of a 60 Hz transistor oscillator solves this switching problem very nicely, so long as its load is not of the type that will pull the frequency – for example – equipment containing input power transformers. To eliminate these load effects the circuit shown in Fig. 1 was developed. We shall call it Unit A. It consists of a 60 Hz free-running multivibrator, Q1 and Q2, whose outputs, phased 180° from each other, are fed through buffer amplifiers Q3 and Q4 to the switch drivers, Q5 and Q7. Q5 and Q7 are over-driven to square the waveforms and to supply the 0.5A input signals required by the power transistor switches, Q6 and Q8. This high current is necessary to keep Q6 and Q8 in saturated conducting condition so that very little voltage is dropped across the emitter to collector junction. This condition reduces internal heating (P=EI) to the minimum possible. Q6 and Q8 alternatingly snapping off and on changes the current flow through the transformer primary, which is coupled to the step-up secondary, and produces a 110V ac output.

While trying to power a receiver and a transmitter from the same inverter, I uncovered a formidable voltage regulation problem. To get around this trouble another inverter was constructed that would carry the heavy transmitter power, Unit B. This circuit, Fig. 2, was made for high

current, and its switches consist of two parallel connected transistors, Q9 and Q10 in one, and Q11 and Q12 in the other leg of the transformer primary. When the mode switch S3 is in the slave position, these transistor pairs are driven by a centertapped 6.3V filament transformer, T2, which is excited by the square wave output of the frequency controlled inverter, Unit A. When the mode switch is in the master position, Unit B changes from an amplifier of a sort to an oscillator tuned to 60 Hz. Current limiting resistor R17 is switched to a voltage divider, furnishing forward bias to the power transistor switches, and at the same time, the output of the inverter is switched to the primary of T2 at the proper phase to sustain oscillations. The mode switch is a refinement that adds flexibility to the unit by allowing it to operate independently of any outside circuitry.

The construction of the inverters is not difficult. One of the reasons is that the physical appearance of either one can be anything that pleases the individual. Nothing is critical as far as pickup or lead length is concerned. However, we are using relatively high current, five to twenty Amperes, so any long wire runs to the power circuits should be heavy gauge. It is very easy to drop a couple of volts through the leads connecting the inverter to the auto battery if they are not much larger gauge than necessary to protect them from overheating. One volt drop at the input results in ten volts less at the output. It is recommended that jumper cables of the type that are made for starting one car from another's battery be used for the input leads.

Inverter Unit A was constructed around a chassis that just fits its transformer. The case is made of solid 1/32-in. thick aluminum with the back and top the perforated type. The front panel was doubled so as to provide a firm mounting for the power switch, S1, fuse, F1; indicator lamp, I1; and receptacle, J1. A piece of belt looped over the top makes a convenient carrying handle. The multivibrator and buffer circuits, because of the nature of their parts, are assembled on a Vectorboard. These circuits, containing Q1 through Q4, are

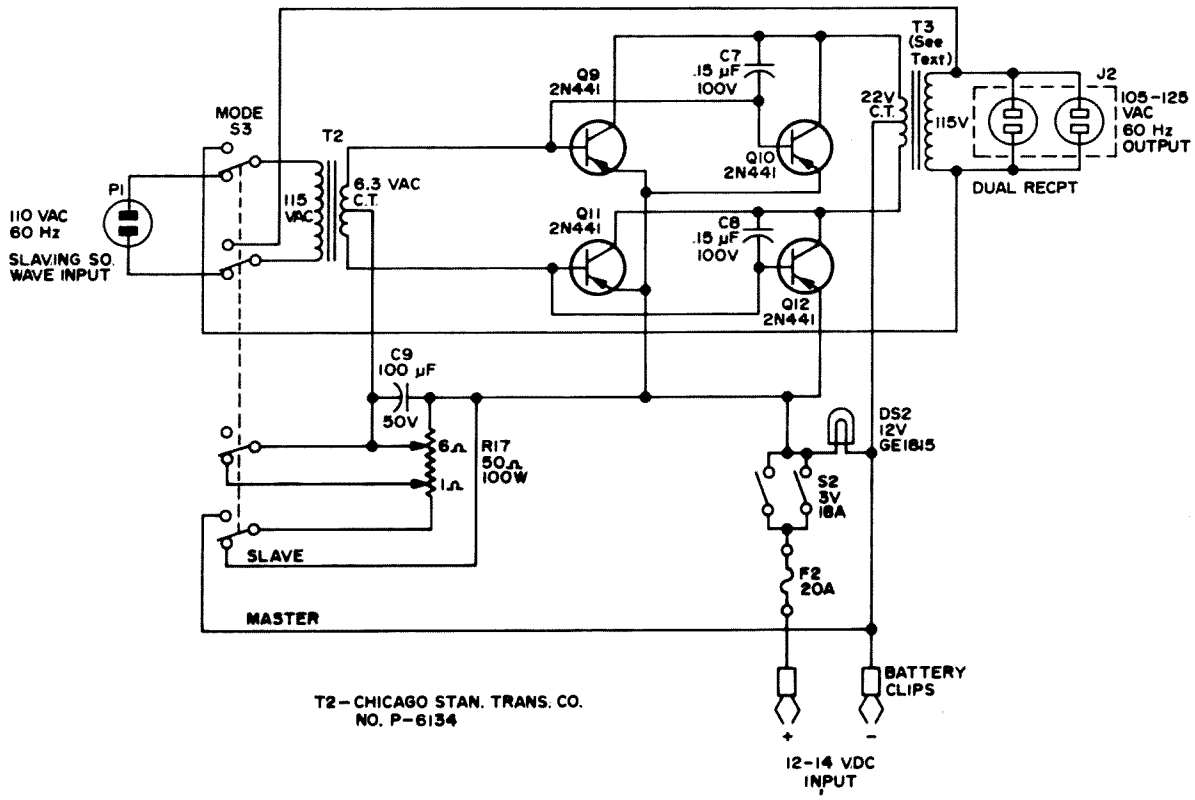


Fig. 2. Unit B inverter.

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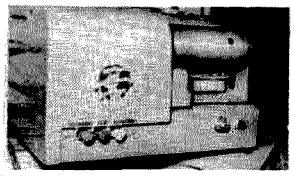
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neatly arranged on a 4¾ in. by 2¾ in. piece; a size that provides room for flea-clip tie points around its edges. After this assembly is wired, it can be tested before it is mounted above T1, by the use of clips that hold it just inside of the back cover. The switch drivers, Q5 and Q7, generate no heat, but for the sake of a place to put them each one is mounted on the bottom of the heatsink containing its switching transistor, Q6 and Q8, respectively. These transistors are spaced at 2 in. and are centered as well as clearances will allow.

The heatsinks are assemblies of scrap aluminum, each consisting of three pieces of 1/32 in. and one piece of 1/16 in. thick material. All are 6 in. long and are bent into "U" channels with legs 1¼ in. high and widths of 3¼, 2 5/8, and 1 3/8 in. The narrowest is made of the thicker material. These channels are nested together, being sure that each one is flat against the other. The transistor mounting bolts hold the pieces together. Homemade heatsinks require a surprising amount of material and make commercially available ones very attractive.

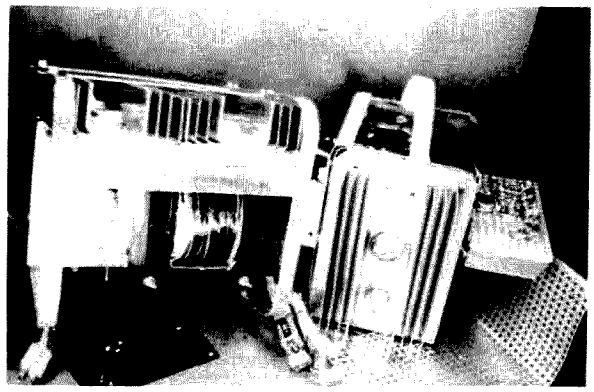
The transistors are insulated from the heatsinks by using mounting kits. T1 is a TV transformer which has a low voltage complement of two 5V rectifier filament windings along with one of 12.6V, center-tapped. One end of each 5V winding is connected to opposite ends of the 12.6V winding. They are phased so that when the transformer is energized the voltage measured across the three series connected coils is 22.6V ac and 11.3V ac from each end to the centertap. This 22.6V winding is used as the inverter's primary and is connected to the switching transistor collectors. The 110V winding (the original input winding) is used as the inverter's secondary and is connected to the output receptacle.

The rest of the leftover high voltage outputs are separated and fastened out of the way to flea-clips along the outer edge of the Vectorboard. The potential of these wires is very high, about 700V ac, so keep clear of them when the inverter is operating. TV transformers of this type are not uncommon and save lots of work winding a

useful primary. If a TV transformer of this type cannot be found, then one must be modified in the manner described in Unit B's construction procedure for T3.

Unit B has a different layout because a 7 x 5 x 2 in. chassis happened to be laying in front of me at the right moment. The heatsinks are identical to those of Unit A, with the transistors equally spaced from each other and the edges. These transistors are bolted directly to the heatsink surface without insulators. This allows better heat conduction and not too much added construction difficulty, keeping the heatsinks insulated from the rest of the chassis. The two heatsinks, one containing Q9 and Q10, the other Q11 and Q12, are bolted 1/8 in. from each other to a 1¾ x 7 in. piece of insulating board running across their top and to a second piece across their bottom. Large clearance holes are provided for the lower bolts through the rear side of the chassis, and the lower insulating board is drilled and bolted in this location. The heatsinks will then be held firmly vertical. R17 is fastened to the inner side of the top board along with a curved shield over it for protection. Roll bars made of 3/32 in. thick metal are run around the outside edge of the unit to keep the heatsinks from coming into contact with any conducting obstruction and to be used as carrying handles. These bars are also tied together with two ½ in. strips of insulating board across the back where the heatsinks might be bumped. The power switch, S2, is a DPST with both sections connected in parallel so it will carry the input current. This switch; the mode switch, S3; indicator lamp, I2; and receptacle, J2; are attached to the front of the chassis along with a liberal number of labels and high voltage signs. The input leads enter the back of the chassis, where the fuse is also placed, and T2 and T3 take their place on the top surface.

T3 is a modified TV transformer. The primary current requirement for Unit B is too high to permit the use of the existing windings. To modify it the end bells are removed, the filament windings unwrapped, and the high voltage leads cut



Unit B – top view (left) and Unit A – side view (right). The T3 winding seen is ½ of its new primary. The Vectorboard is tilted outward to show its inner side.

short and insulated, all without disassembling the core. There is very little chance that the filament winding will not be the first layer. When taking off the original windings, count the number of turns of the coil of a known voltage, so that when the new primary is wound, 23V of turns can be replaced. For example, if the 5V coil had eight turns, for 23V you would need 8/5 x 23 which equals 36.8 turns. Rounding this figure to the nearest half will not affect the end result. Number 14 gauge enamel wire is used, and it is divided into two pieces, each long enough for one 11.5V coil. The length of these pieces is determined by wrapping a short wire around the coil once and measuring it. Multiplying that length by the number of turns required will give the approximate length. Allow about three feet for safety. The sharp edges of the core are covered with masking tape, especially between the coil and the core, and the wire is slid under the core and around the coil the required number of turns. It will not take more than two layers, which are separated by brown paper. There will be ample room, because all kinds of high voltage insulation will have been removed along with the filament windings.

After the coils are completed, jam pieces of cardboard between the coils and the core to hold the wire in place. The four ends are marked so that you will know which two are going to make the centertap. Energizing the transformer from its normal primary is advised before the leads are cut to size. This way any errors that might

have occurred may be detected and corrected by adding or removing wire. The ends of this primary connect to the power transistor collectors and the centertap to negative power lead. The 110V winding will become the secondary and connects to the receptacle.

Before applying power to either unit some precautions should be observed. Be sure that your auto electrical system is able to supply the required current. To give you something to work from, my 1964 Chevy shows no ill effects. Be constantly on the alert for overheating transistors. Any large temperature difference between the heatsink and the transistor should be regarded as overheat as the heatsink is supposed to lead all normal heat away from the power transistors. Excessive heat will ruin these transistors and is an indication that they are not being driven "on" hard enough. Voltage transients will also cause damage, so do not operate the inverters with an unloaded output.

Before you power Unit A, R10 should be set. If the frequency of the multivibrator was not set when the Vectorboard assembly was tested, turn R10 fully CCW and back 1/8 of a turn. Connect the input power leads directly to the battery terminals. Plug a 50W lamp into the output receptacle and place the power switch on. The lamp should glow brightly. Check the power transistors for overheat as quickly as possible. Check the output waveform with your oscilloscope. It should be symmetrical and square as a box and have the frequency of 50 to 60 Hz. Touch up R10 if necessary to change the frequency, but try to keep it as near CCW as possible. If heat is noticed or the wave is unsymmetrical change Q1 with Q2 or Q3 with Q4 to balance the drive. Plug a second lamp into the receptacle, a 40W one. If both lamps are glowing brightly and there is no excessive heating, Unit A is ready for use.

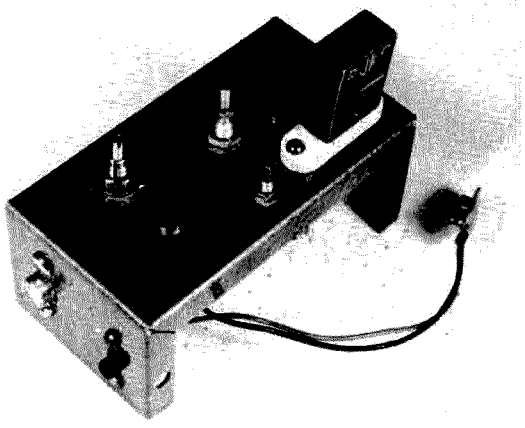
Before powering Unit B, adjust the taps on R17. The tap near the S3 end of the resistor should be located 1Ω from that end, and the top near the positive end should be positioned 6Ω from that end. Connect a 100W lamp to the output receptacle, connect the power leads directly across the battery terminals, set the mode switch to "master", and place the power switch on. The lamp should glow brightly. If it does not glow, the feedback from T2 is most likely out of phase and reversing its primary connections will correct the fault. The tap at the positive end of R17 can be readjusted so that the lamp will glow immediately after the power switch is placed on, but as close to that end as reliable operation will allow. Set the mode switch to "slave" and the lamp will go out. Plug the drive cable into Unit A's receptacle along with a lamp. When Unit A is operating, the lamp in Unit B will glow. Bring the lamp load up to 200W and check for transistor overheat. To reduce any excess heating, adjust the tap on R17 near the S3 end closer to that end. This will increase the signal to the power transistor bases. The output of Unit B should be a duplicate of Unit A, when in the slave mode. When in the master mode the output is still square and the frequency very close to 60 Hz.

Some possible changes to the components of the system that have been tried and might be of interest follow: First, the switch drivers of Unit A are powerful enough to drive two parallel connected 2N441 transistors. This will raise its output capability to almost that of Unit B, 180W, providing T1 has a large-gauge primary. Also, the drivers will handle four diamond power transistors parallel connected in each primary leg. What the output capability will be depends upon the quality of the transistors, but should not be less than the original 90W. Unit B does not require parallel connected switches or modified transformer if it will not be called upon to deliver more than 100W. I have not tried either unit at frequencies other than 60 Hz but do not see why changing the transformers and multivibrator will not allow both units to work well at 400 Hz. The ultimate application of the idea presented here will come when some homebrewer designs his transmitter's power supply so that it may be plugged into his 110V ac home outlet, or into his auto's 12V dc system without fuss of any sort.

. . .K3QKO■

Jim White W5LET
100 Dianne Street
West Monroe LA 71291

HOT CARRIER DIODE CONVERTER



For several years most of my hamming has been done with a three-band transceiver. Now, that's fine most of the time, but then there are times when I get to wondering what's going on on the other bands. So I began to look around for a good, simple, economical solution. It was during this search that I ran across the hot carrier diode.

One of the claims made by the manufacturer – "The hot carrier diode's performance . . . can be described as closely approximating the ideal diode" – started me to wondering just how well they would work in a 15m converter. So four of them were purchased, and the converter described here is the result.

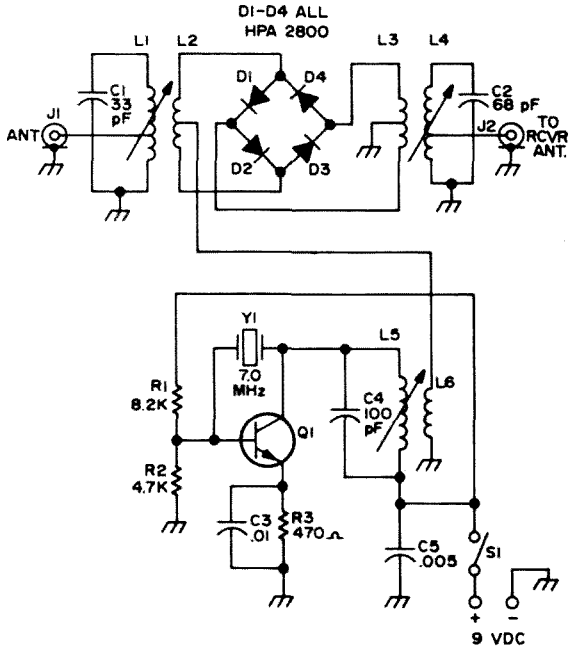


Fig. 1. Circuit of the 15m converter.

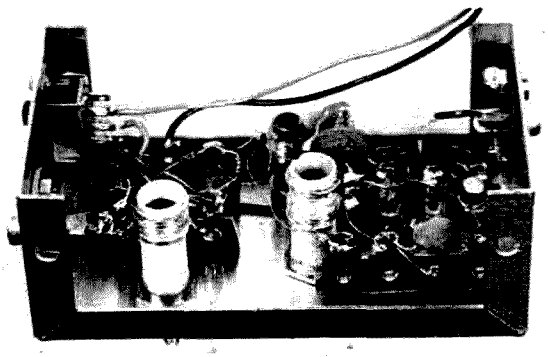
How do they work? The fantastic claims made for them are no exaggeration. They make excellent low-noise mixers and there is very little loss of signal. Consequently no rf amplifier is necessary. These diodes also possess a large dynamic square-law range which helps considerably with cross-modulation problems. When you add economy and simplicity to these advantages, what else could one want in a converter?

The particular diodes used in this converter, HPA 2800s, are made by Hewlett-Packard and are available from them for less than a dollar each. If you don't know where your nearest Hewlett-Packard distributor is, write directly to Hewlett-Packard, 620 Page Mill Road, Palo Alto, CA.

Circuit Description

The four diodes, D1–D4, are arranged in a balanced circuit. Both the input and the output are tuned, the input to 15m and the output to 20m. Because the input and output impedances of the detector arrangement are rather low, link coupling is used to couple to these tuned circuits.

The local oscillator is straightforward in every respect. It uses a 2N706 along with a 7 MHz crystal. I used an old FT243 type because I happened to have it. If you have a good active crystal in another type of holder, use it. Of course you will have to change the crystal socket to fit your crystal. The collector of the 2N706 is tuned to 7 MHz with a 3/8 in. diameter slug-tuned coil.



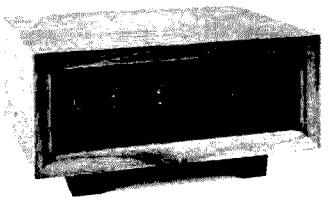
Construction of the Converter

The hot carrier diode converter is built into a small minibox (Bud CU-2101-A). Take a good look at the photograph and you can see the arrangement of the parts. The oscillator components are mounted at one end and the diodes and associated parts are at the other. All of the small parts are mounted on terminal strips. No socket is provided for the transistor. It and the diodes are soldered directly to the terminal strips. Use caution in soldering these devices in place: Too much heat will destroy them, and quickly. My method of doing this is to solder all other parts in place leaving these until last. Be sure you observe the polarity of the diodes.

Antenna coil L1 consists of 17 turns of 28-gage enameled wire close-wound on a ¼ in. slug-tuned form. It is tapped 5 turns from the bottom. L2 consists of 4 turns of 28-gage wire wound over the center of L1 and is centertapped. Both the output and oscillator coils are wound on 3/8 in. slug-tuned forms. Output coil L4 is 11 turns of 26-gage wire tapped 3 turns from the bottom. L3 is 3 turns centertapped wound over the center of L4. Oscillator coil L5 is 30 turns of 30-gage wire close-wound. L6 is 5 turns of 30-gage wound over L5.

I used RCA phono connectors for the antenna as well as output connections. If you prefer coax connectors you will have to use a larger box. The power switch is a miniature slider type. The converter is powered by a 9V miniature transistor battery.

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Adjustment and Operation

Connect the converter output jack to the receiver (or transceiver) with a short shielded cable. Connect an antenna and the 9V battery. With the receiver on and tuned to 14 MHz, turn the converter power on and you should hear the second harmonic of the crystal oscillator in the converter. You might have to tune slightly to find it. If you don't, adjust the slug in the oscillator coil until you do. With the oscillator working, tuning higher on the receiver should bring in 15m signals. Peak L1 and L4 for maximum signal strength.

Using this little converter with a National NCX3 brought surprisingly good results. DX signals come in like locals. For the price and labor involved, it's a little jewel.

. . .W5LET■

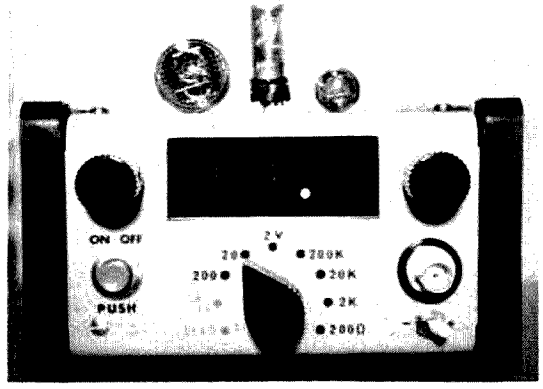
Ronald Vaceluke W9SEK
17 West 540 Hillcrest
Wood Dale IL 60191

RTL DECADE AND DRIVER

There have been numerous articles using inexpensive RTL (resistor - transistor - logic) integrated circuits in frequency counters and in digital volt-ohmmeters. A good friend, Joe WA9CGZ, built the digital volt-ohmmeter from a magazine article[1], and, after making some changes in its circuitry (to improve its drift problem), brought it over for me to try. I was favorably impressed, but it left me cold in one respect. It had "idiot lights" for readouts, as do all the other frequency counters I've seen in the ham magazines. What do these flashing lights do? They get your eyeballs sore from jumping up and down and left and right while trying to follow the reading. I don't know about some people, but I was trained at a young and tender age that we read from left to right in a straight line. It's so much faster and easier.

To get back to Joe's voltmeter, I decided to build one, but with a different readout method. After looking over the many types (7 segment, projection, and others) I decided that the old gas-discharge numeric indicator was still a good performer, and so I chose it. As can be seen from the photograph, this type of tube comes in varieties of sizes and shapes. They are manufactured by National Electronics, Raytheon, Amperex and others. Lately these tubes have been appearing on the surplus market, but as it says in the back of *73*, Caveat Emptor! The NL-5750 is about the least expensive of indicator tubes on the market, and is stocked by Newark Electronics in Chicago as well as others.

There are disadvantages, of course. (You want to have your cake and eat it, too?) The first is cost. These tubes do cost more than ten pilot lamps; however, most of the tubes are rated for 200,000 hours of service. If ten long-life lamps were used, then the lamps would cost more than the tubes.



Front view of the DVOM using the decade divider and driver discussed in article. Several types of gas discharge indicator tubes are on top. The one on the right is the type used in the DVOM. The cabinet shown is by Justin.*

The second disadvantage is that at least 170V dc is needed for the gas discharge tube. In the case of the voltmeter mentioned above, this was not a problem since the voltage was already there. Since the tubes draw only 2 or 3 μA each, it isn't difficult to get one way or another.

Now to get a working circuit. In looking over some of the circuits used by others, I found that several different binary counting systems were used (there are many types – gray, bi-quinary, excess three, and more); however, these didn't have much appeal because of the difficulty in decoding. For those not familiar with binary counting, let's just point out that in the binary counting system we count with the base two instead of base ten as in our familiar decimal system.

*Justin Inc.
2633 North Lee Avenue
So. El Monte CA.

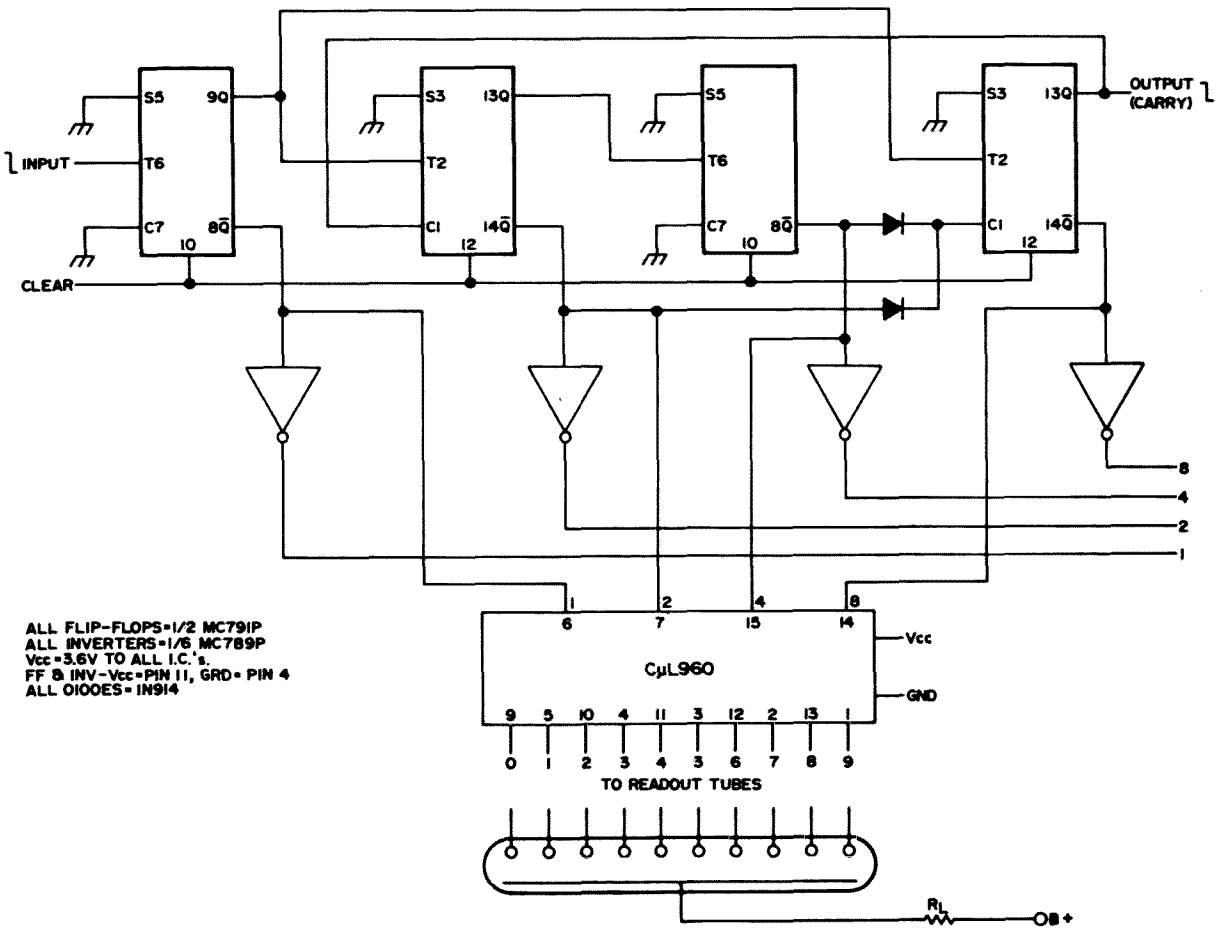


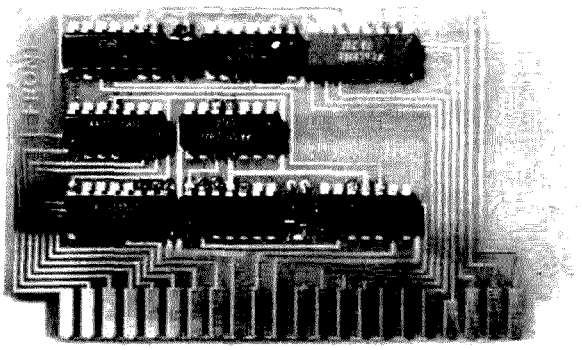
Fig. 1. Notes: All flip-flops ½ MC791P, all inverters 1/6 MC789P, Vcc is 3.6V to all IC's, F.F. & Inv. – Vcc Pin 11 – gnd pin 4, all diodes 1N914.

So we have to change the binary numbering system to the decimal system. This can be done with discrete components (diodes, resistors and transistors), but this costs as much as using a single integrated circuit. The single IC route was chosen for simplicity; the one used is made by Fairchild, and is completely compatible with RTL ICs. This choice limits our binary code selection since the μL 9960 requires an 8421 BCD (binary coded decimal) input. This is a common code used in the industry; I'll tell you why later. All that is needed now is a Mod 10 that has a 8421 BCD output.

Since four flip-flops can count to sixteen, we can permute them to count only as high as ten. As can be seen from the schematic, the outputs of the Mod 10 come off from the "NOT" side of the stages because the 9960 requires negative logic. A word about the flip-flops . . . MC791P's made by Motorola were used. These have the same pin connections as the widely used MC790's, but are capable of the greater output needed here. Do not use the MC790!

I felt that a BCD output could prove useful in the future to drive a digital printer so it is necessary to bring only the four leads from the Mod 10 out. This could be done directly off the counter, but is not desirable because the added capacitance of long leads could pick up stray rf and cause false counting. The best way is to buffer the output and this is easily accomplished with another IC, the MC789P hex inverter. By connecting the inputs of four of the inverters to the 8421 negative logic side of the Mod 10, we have a buffered output of 8421 positive logic. The remaining two inverters are not used. The positive logic output, which is more commonly used than negative logic, will drive 5 RTL or 3 DTL or TTL loads.

I built two identical circuits on a double-sided printed circuit board[2] that plugs into a double 22-pin connector. I used this method



Front view of the double-sided PC board used to hold two decade dividers and drivers.

to save space and provide greater ease of repair should it ever become necessary (the remainder of the voltmeter was built on two more boards of the same size). Hand-wiring of the circuit can be used, of course, but I recommend the plug-in method in either case.

By cascading as many of these stages as you desire, you can make a frequency counter with the addition of a time base and appropriate gating. Just look over the circuits of frequency counters that have appeared in magazines in the last couple of years. If it uses RTL, chances are you can substitute a circuit for the one used and have an easier time reading out the answer. If you feel that a buffered BCD output will never be necessary, then omit the inverter stage.

Happy counting.

...W9SEK

Glossary

Positive logic – Where the logical "1" is more positive than logical "0".

Negative logic – Where the logical "1" is more negative than logical "0".

Modulo (Mod) – A counter circuit. The number indicates how many pulses are counted, i.e. a Mod 10 counts 10 input pulses. The output occurs on the 10th pulse. A Mod 5 will count 5 pulses, etc.

Permuting – A means of providing a feedback path to stages into counter to force it into desired state.

References

[1] Lancaster, Don – Digital Volt-Ohmmeter, *Popular Electronics*, Dec. 1968, Page 29.

[2] The printed circuit boad shown is available for $5.50 each P.P. from: *R.M.V. Electronics, Box 283, Wood Dale IL 60191.*

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8	9	10	11	12	13	14
15	16	⑰	18	19	20	21
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EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	7	3	3	3	7	7A	14	14	14
ARGENTINA	14	7A	7	7	7	7	14A	21	21A	21	21	21
AUSTRALIA	21	14	7B	7B	7B	7B	7B	14B	14	14	21	21A
CANAL ZONE	14	7A	7	7	7	7	14	21	21	21A	21A	21
ENGLAND	7	7	7	3A	7	7	14	21	21	14A	14	7
HAWAII	14	14	7B	7	7-	7	7	7B	14	21	21	21
INDIA	7	7	7B	7B	7B	7B	14	14	14	7B	7B	7
JAPAN	14	7B	7B	7B	7	7	7	7	7B	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	14	7B	7B	7B	7B	7B	7	14B	7	7	7B	14
PUERTO RICO	7A	7	7	7	7	7	14	14	14	14	14A	14
SOUTH AFRICA	7	7	7	7B	7B	14	21	21	21A	21A	21	14
U. S. S. R.	7	3A	3A	7	7	7B	14	14A	14	14	7B	7
WEST COAST	14	7A	7	7	7	7	7	14	21	21	21	21A

CENTRAL UNITED STATES TO:

ALASKA	14	14	7	7	3	3	3	7	7A	14	24	14A
ARGENTINA	21	7A	7	7	7	7	7A	21	21A	21	21	21
AUSTRALIA	21	14	7B	7B	7B	7B	7B	14	14	14	21	21A
CANAL ZONE	21	14	7	7	7	7	7A	21	21	21	21A	21
ENGLAND	7	7	3A	3A	7	3B	7B	14	14	14	14	7B
HAWAII	21	14	14	7	7	7	7	7	14	21	21	21
INDIA	7	7B	7B	7B	7B	3B	3B	7A	14	7B	7B	7
JAPAN	14	14	7B	7B	7	7	7	7	7	7B	7B	14A
MEXICO	14	7	7	7	7	7	7	14	14	14	14A	14A
PHILIPPINES	14	14	7B	7B	7B	7B	7	7	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	14	21	21	21	21	21
SOUTH AFRICA	14	7	7	7	7B	7B	14	21	21	21	21	14
U. S. S. R.	7	3A	3A	7	7	3B	7B	14	14	14	7B	7B

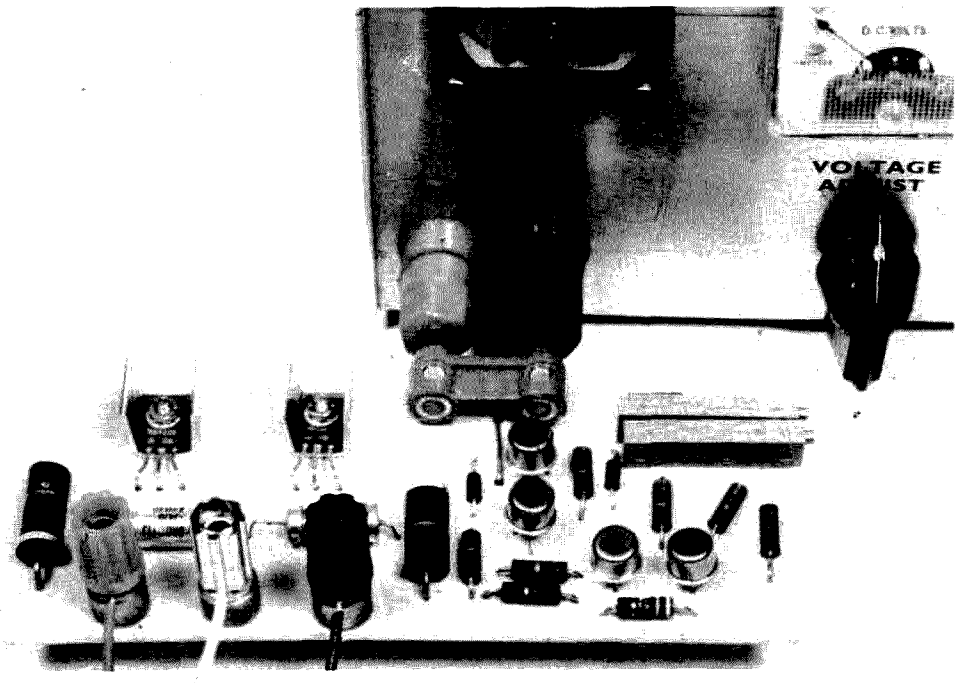
WESTERN UNITED STATES TO:

ALASKA	14	14	7	7	3	3	3	7	7	14	14	14
ARGENTINA	21	14	14	7	7	7	7B	14	21A	21	21	21
AUSTRALIA	21A	21A	14	14	7B	7B	7B	7	14	14	21	21A
CANAL ZONE	21	14	7	7	7	7	7	14	21	21	21A	21A
ENGLAND	7B	7	3A	3A	7	3B	3B	7B	14	14	14	7B
HAWAII	21A	21	14	7A	7	7	7	7	14	21	21	21
INDIA	7B	14	7B	7B	3B	3B	3B	7	7A	7A	7B	7B
JAPAN	21	14	14	7B	7	7	7	7	7	7B	14	14A
MEXICO	21	14	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	14	7B	7B	7B	7	7	7	7	7B	14
PUERTO RICO	14	7A	7	7	7	7	7	14	21	21	21	21
SOUTH AFRICA	14	7	7	7	7B	7B	7B	14	14	14A	21	14A
U. S. S. R.	7B	3A	3A	7	3B	3B	3B	7B	14	14	7B	7B
EAST COAST	14	7A	7	7	7	7	7	14	21	21	21	21A

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

Hank Olson W6GXN
Box 339
Menlo Park CA 94025

A POWER-SUPPLY SPLITTER FOR LINEAR IC'S



In a previous article, two dual regulated power supplies were described for use with the new linear IC's, which require ±6V or ±15V.[1] While the dual supply approach is not a bad one, the method herein described has several advantages. By plugging this "splitter" into any existing regulated power supply, a centertap is electronically created which will stay midway, voltage wise, between the plus and minus terminals. This centertap will stay at the midpoint even if current is drawn from it, and will stay at the midpoint even when one varies the supply voltage. This relaxes the requirement of extremely good supply regulation, as most linear amplifiers are more tolerant of supply voltage changes if the positive and negative voltages change equally.

The splitter is built on an etched circuit board, with a dual male banana-pin plug mounted on it for direct connection to one's regulated supply. Three binding posts are similarly mounted on the board and serve as the output terminals. The splitter is shown in use in the photo, operating with a regulated power supply I have previously described.[2]

The original circuit of a similar splitter appeared in one of the engineering magazines, and as such was not exposed to ham readership.[3] Also, the original circuit used semiconductors that are either too expensive or hard to obtain for hams. By use of economy transistors, the price of parts of the splitter herein described is a fraction of the price of the parts required to build the original. Two type-numbers are given for each semiconductor in the circuit of Fig. 1,

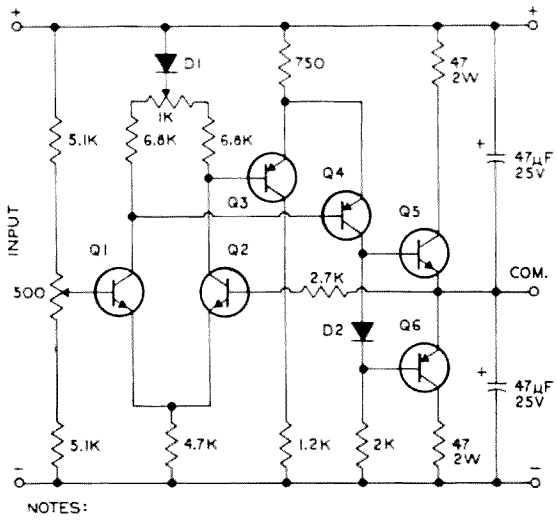


Fig. 1. Power supply circuit.

the Motorola HEP numbers being the more available types. The other type-numbers are perhaps more readily obtainable by those hams who work in the electronic industries and regularly deal with large industrial electronic supply houses.

The etched circuit board and the parts placement on it are shown in Figs. 2 and 3. Note that the MJE 370, MJE 520, HEP 245 and HEP 246 are in what Motorola calls a "Thermopad package." Heat dissipators may be easily and inexpensively made for these transistors out of small "U"-shaped pieces of aluminum or copper sheet, as shown. The circuit board was laid out to fit Beckman 78PR type trim-pots (cermet).

Once the parts have all been soldered to the board – an easy hour's effort – you're ready for testing. I think it best to try the splitter on a current-limiting type supply, such as that described in reference 2, with the current limiting set to about 50 mA.

The regulated supply feeding the splitter is set to 24V, so that the output of the splitter will be ±12V. The reason for calibration at this voltage is that it is in the middle of the useful operation range (10–40V input) and also it fits the 12V requirement for one of the *best* operational amplifiers that I have found – the General Electric PA223. The splitter will draw about 15 mA with no load; if it draws considerably more, check for soldering errors or faulty semiconductors. The 500Ω trimpot is adjusted until the plus and minus outputs are equal. The setting of the 1000Ω trimpot is more tedious; the setup is shown in Fig. 4. Offset of the centertap from a true "split" is indicated by the VTVM as the input voltage

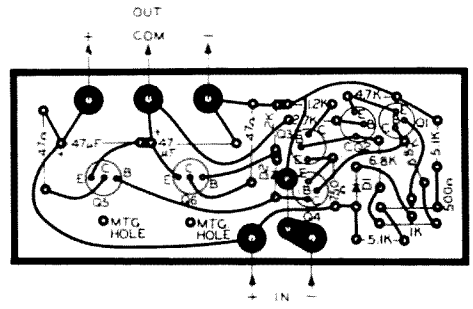


Fig. 3. Circuit board, parts placement.

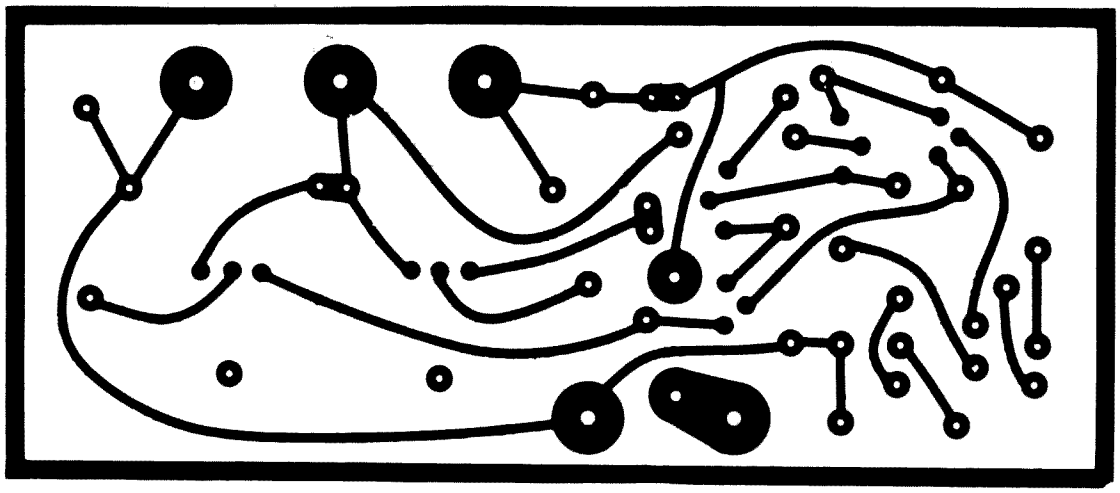
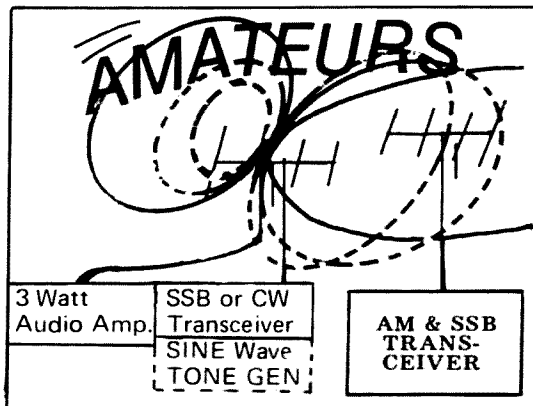


Fig. 2. Circuit board shown copper side up (80% reduction).



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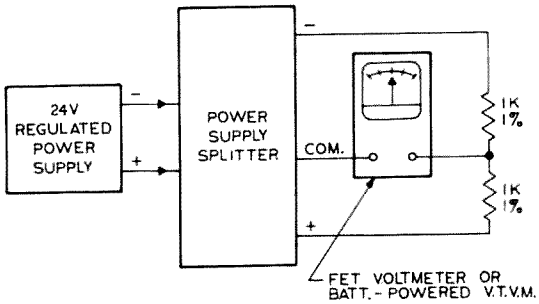


Fig. 4. Test setup for setting adjustment pots on splitter.

is varied from 10 to 40V. The offset is corrected by adjusting the 1K pot, and again sweeping the input voltage from 10 to 40V. This procedure is repeated until the best approximation to perfect splitting is obtained.

The splitter can deliver up to about 100 mA through the centertap, but this should rarely be necessary, since the main current drawn by operational amplifiers and other linear IC's is between the plus and minus terminals. The splitter has been used to power Fairchild μL709's and National LM201's on ±15V, General Electric PA223's on ±12V, and General Electric PA238's and RCA CA3029's on ±6V, all with success. As the world of linear IC's expands, this simple power supply splitter may easily become the handiest piece of bench equipment you own (next to the basic regulated power supply, of course).

I wish to thank Russ Wolfram W6ERX for his help in developing the circuit from its original form to the amateur version shown. Circuit boards and kit of parts are available from A.R.S. Enterprises, P.O. Box 555, Tempe AZ 85281.

. . .W6GXN

Bibliography

1. Olson, H. "IC-Regulated Power Supplies" *Ham Radio*, March '68, p.28.
2. Olson, H. "A Laboratory Power Supply" 73, Dec. '66, p. 38.
3. Sylvan, T. "Regulator Makes Two Power Supplies Out of One" *E.E.E.*, May '66, p. 117.

Parts List

1. Circuit board: A.R.S. Enterprises, P.O. Box 555, Tempe AZ 85281.
2. Input plug: Pomona MDP-ST sawed off as shown.
3. Output terminals: General Radio 938-C, 938-D, 938-G (one each) and three 938-F.

LETTERS

(Continued from page 12)

cerned, who had six children to support, had been hauled into a Cleveland court for wearing an American flag on the seat of her pants, and with the suspension of her subsequent $1000 fine and thirty day jail sentence, had been properly humbled (humiliated) to the point of telling the judge, meekly, " . . . Yes, she thought it was a pretty good government, after all." Obviously this situation is emotionally, socially, and politically supercharged – it is much deeper than the level at which Mr. Russell chose to use it as a ploy for the introduction of his pro-League argument. Yet this is exactly what he did, i.e., use the words of a troubled welfare mother as a good example of how we ought not knock our "good government," or our good League. This is nothing but patent – and potentially dangerous – malarky. This kind of thing belongs nowhere in amateur radio – a realm of technical, not social, investigation – let alone the editorial pages of *QST*. Yet, there it was, in black and white. I wrote to ARRL in protest. My letter was not printed in *QST*, though W8BU had had a *second* letter of his printed as the first letter in the correspondence section of the *same November issue*! Check this out (page 88) if you do not believe me. Where does this man get off? Does he own the ARRL? I am an ARRL member, Extra Class, etc., just as W8BU is. How does he, or anyone, rate *two* letters in one issue, one of them printed as an editorial, no less, to my *zero* letters – especially when one of them is untenably political and potentially divisive in its implications? The ARRL would not answer me on this – John Huntoon told me in his answer to my letter that I had misinterpreted W8BU. I ask, what is there to misinterpret? It is all there in print, in *QST*. Moreover, *no* letters protesting W8BU's ill-considered stand were printed – while letters supporting him were, e.g., one by K8MMH/9, of Buffalo Grove IL, a personal friend of W8BU (by the way, try to find Buffalo Grove on the map). Yet I *know* protest exists – I protest this. WA9SZQ protests it. I brought this issue to the attention of the ARRL Hawaii SCM, KH6BZF, one night on twenty meters and he admitted, after I had stood by for him to read the editorial, that he felt like hanging his life membership plaque upside down on the wall of the shack. What I want is for all ARRL members who feel likewise – and I urge those of you who haven't read W8BU's editorial to do so – to write their Division Director, as well as Headquarters, demanding the retraction of this editorial. That's all I want, that, and that the amateur world know there are people who disagree with W8BU and ARRL on this and were not allowed to express that disagreement in the same forum that bred it – the pages of *QST*. That's why I ask your help in printing this – injecting politics of any kind into ARRL policy is bad, but apparently ARRL has an even worse policy of not allowing dissent against its major blunders to be voiced. Let's get that editorial retracted!

Sgt. Peter Erk WA9TCR/KP4
Camp Garcia, Vieques, P.R.

Please tell me what the number '26009' under the date and price on front covers for the last couple of months means?

Really enjoy the magazine.

Dick Altman
San Francisco CA

Roughly half of 73's copies are sold on the newsstands and this is being handled by a national distributor. Newsstands keep track of magazines by means of the little code number on the cover. Right near the number you will find the insignia of the distributor, Ace News.

I thought you would like to know that 6 xtals for my TR-22 from KW Industries and all were OK even without a tune-up. They also delivered within a week including 2-way mail.

Jim Kirkgasser WA2ELA

This letter is a little negative feedback, and an offer to help.

The article in the August issue, "The 1926'er: The Ideal Crystal Oscillator,' may describe a fine oscillator that performs as claimed, but the "How It Works" is pretty far off base. In fact, it's down-right wrong. Some unsuspecting reader may believe the statement on page 116 that says the crystal provides 180° of phase shift. It just ain't so!! Maybe Bill Hoisington can't be objective about his own analysis, but the theory of operation given implies a basic misunderstanding of crystals and oscillators; his 30 years notwithstanding.

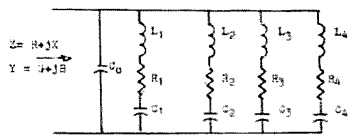


Fig. 1. Crystal unit equivalent circuit.

Control crystals have the generally accepted electrical equivalent circuit shown in Fig. 1. Ordinarily the first mesh is sufficient for analysis of the operation of the crystal unit. The extra branches account for the spurious mechanical responses that often affect the measured response. The impedance variation of a crystal unit near the principal mechanical resonance is shown in Fig. 2. There are two frequencies at which the reactance is zero, or where the crystal resonates. (This zero reactance point is the classical definition of resonance); the resistance is very low at one and very high at the other. The lower frequency, at which the resistance is very low, is referred to as the series resonant frequency, and the higher frequency, at which the high impedance is seen, is referred to as the anti-resonant or parallel resonant frequency. Crystals operating on a mechanical overtone have a low impedance and appear to operate in the series mode. The impedance of the crystal unit is near zero and resistive. (The holder capacity or load capacity, Co, has minor effect when shunted by the low impedance series-tuned circuit.)

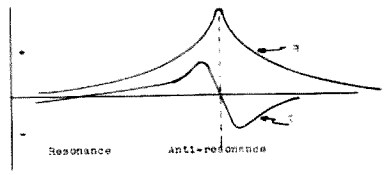


Fig. 2. Crystal unit impedance variation.

The fact that the oscillator circuit uses the crystal unit between collector and base does not mean the crystal provides 180° of phase shift. (In the Pierce oscillator, the crystal is between plate and grid, and I don't believe anyone claims 180° in that application.) So, if the crystal operates at series resonance with nearly zero reactance, how does it work? To explain the operation, I'll assume a qualitative understanding of the Clapp oscillator, and go from there. A typical Clapp oscillator is shown in Fig. 3; bias sources are not shown. At the lower frequencies, the capacitors Cbe, Cce, and Ccb may be physical capacitors augmenting the internal capacitance of the transistor. At higher frequencies the transistors internal capacity may be enough. In passing, note the similarity between the equivalent circuit of the crystal and L, Ct, and Ccb in the Clapp's resonant circuit.

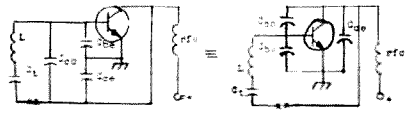


Fig. 3. Typical Clapp oscillator.

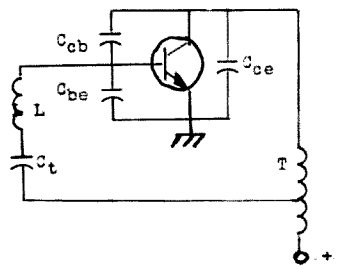
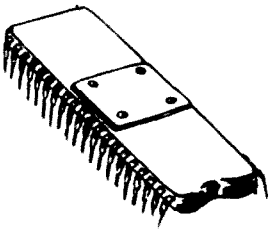


Fig. 4. Modified Clapp oscillator.

Generally, the oscillator designer can choose components compatible with the impedance levels required by the transistor. If such is not the case,

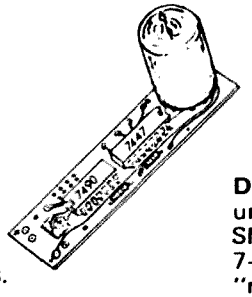
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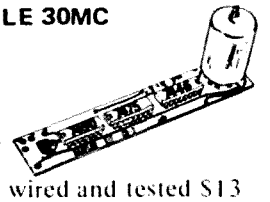
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COUNT DOWN! Only Days, Hours, Minutes before the spectacular opening of the ARRL Hudson Division Convention, October 21–22, Hilton Inn, Tarrytown, N.Y. Plenty of Free Parking. Exhibits, lectures, contests, XL-XYL Events, Gabfests, 2-Meter FM, RTTY, banquet, N.Y. sightseeing. Prominent Banquet Speaker. Fun!

LETTERS CONT.

the impedances can be transformed one way or another to a suitable level. For example, an auto-transformer can be inserted at "X-X" to provide the

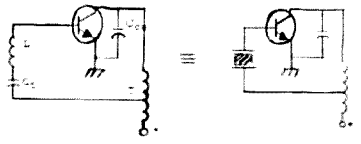


Fig. 5. Modified Clapp oscillator redrawn.

required impedance transformation as shown in Fig. 4. Now, if the circuit is redrawn without showing the transistor's internal capacities, and showing only the physical components, Fig. 5 results. If L and C_γ are replaced by the series-tuned circuit of the crystal, lo and behold we have the "Ideal Crystal Oscillator" sans bias. Now the crystal can be seen to operate in conformance with the laws of physics, and there is no need to demand the impossible 180° phase shift.

If the operation of the Clapp or Colpitts are not understood, let me know and I'll write a tutorial article explaining them and relating them to the real world.

Parker R. Cope W2GOM
Amsterdam NY 12010

That's a lot of Clapp!!

Don't miss the blastoff!! Free gifts to early registrants. Info from Dave Popkin, WA2CCF, 303 Tenafly Road, Englewood, N.J. 07631.

73 MAGAZINES Complete set in binders with all the rare issues. Make offer to WA8DJS, 5733 Linden Dr., Milford OH 45150.

HT-220s WANTED Please write with details, price, to Box 7350, 73 Magazine, Peterborough NH 03458.

HOOSIER ELECTRONICS Your ham headquarters of the Midwest. Individual, personal service by experienced and active hams. Factory-authorized dealers for the finest ham gear on the market – Drake, Regency, Standard, Hy-Gain, Ten-Tec, Galaxy, Cush-Craft, and accessories. Write today for our quote and try our personal, friendly Hoosier service. We accept Master-Charge and BankAmericard. Hoosier Electronics, R.R. 25, Box 403, Terre Haute IN 47802.

TECH MANUALS Only $6.50 each: R-220/URR, R-388/URR, R-389/URR, R-390/URR, R-390A/URR, URM-25D, TT-63A/FGC, LP-5, CV-591A/URR, BC-639A, R-274/FRR, LM-21, TS-34A/AP. W3IHD, 4905 Roanne Drive, Washington D.C. 20021.

IDYLLIC ISLAND WP2M share with retired doctor modern house and ham radio $75 weekly. Jack Beverstein, 60 Amsterdam, Toronto 374 Canada. Telephone 416-755-2117.

73's VOL. 1 NO. 1 (Oct. 1960) to 1970 Incl. Complete, like new. No splits. Best offer FOB. W2NBZ, 11 Great Hills Terr., Short Hills, NJ 07078. (201-379-2164).

GALAXY V MK II w/AC supply, $250. SB-200 linear, $150. Both $350, including keyer, patch. Must sacrifice. WA4ZQO, Box 446, Leesville S.C. 29070.

CLOSED CIRCUIT camera, monitor, 50' RG-59 sound cable, connectors. Never used, 1 yr parts guarantee, $399. Bob, WNØGGD, 5107 Red Barn, St. Joseph MO 65403.

ROBOT MODEL 70 Slow Scan Television Monitor, $375. Hamfest prize, never used, factory warranty, original box. Phil Irvine, 2103 Suzanne Terrace, Huntsville AL 35810.

FOUNDATION for Amateur Radio annual Hamfest Sunday 22 October 1972 at Gaithersburg, Maryland Fairgrounds.

YOUR CALL LETTERS Two sets, for windshield and rear glass. Smart white letters with red outline. Easily installed pressure sensitive decals. $1.00 postpaid, anywhere. Satisfaction guaranteed. Lake Jordon Artists, Slapout AL 36092.

SWAN 270 xcvr. like new, includes built in power supply, Turner 454x mic, Heath swr meter. $350. Charles Jung WA9WRJ, 232 Pierce, Randolph, WI 53956.

SELL International FM2400c Freq meter. Bird model 43 watt meter with hi-band 100 watt plug. $525. Richard Tolar, 52 Calhoun, Grand Rapids MI 49508.

WANTOld Radio Transcription Discs. Any size or speed. Send list and details to Larry Kiner, W7FIZ, 7554 132nd Ave N.E., Kirkland, Wash. 98033.

SSTV, RTTY, WWV, tone to logic decoder projects. Chassis, plans, hardware, eight 2¼" x 3" epoxy cards, $6. Hornung, 1630 Bowling Lane, San Jose CA 95118.

SAROC Eighth National Convention the PRESTIGE convention at the Flamingo Hotel Convention Center, Las Vegas, Nevada 89109, January 4 through 7, 1973. SAROC special room rate $15.00 plus tax, per night, single or double occupancy, only 500 rooms so get your accomodations request in early. Advance Registration $10.00 per person. Registration and eyeball session on Thursday. Seminars, Meetings, Exhibits, open Friday and Saturday. SAROC-SWAN Electronics Social Hour, Friday. Ladies Program, Saturday. SAROC Sixth National FM Conference, Friday and Saturday. SAROC-HY-GAIN/GALAXY Cocktail Party, with Leo WØGFQ, at the Organ, Saturday. SAROC Buffet Hunt Breakfast, with Champagne, Sunday. Advance Registration with Sergio Franchi Flamingo Midnight Show, two drinks, $17.00 per person. Advance Registration with Sergio Franchi Flamingo Dinner Show, no drinks, $21.00 per person. SAROC Jet Roundtrip Vacation Package Plan includes, airfare, Deluxe Flamingo Hotel Room for three nights, SAROC Advance Registration with Flamingo Hotel Dinner Show: via United Airlines departure cities; Baltimore/Washington, $280.00; Boston, $312.00; Chicago, $222.00; Cleveland, $250.00; Columbus, $246.00; Detroit, $244.00; Hartford, $304.00; Milwaukee, $233.00; New York/Newark, $296.00; Philadelphia, $290.00; Pittsburgh, $262.00; via Frontier Airlines departure cities: St. Louis, $209.00; Kansas City, $188.00; Denver, $135.00; Omaha, $182.00; Lincoln, $176.00. The price quoted is per person, double occupancy in hotel room. If single occupancy in hotel room is desired add $25.00 additional per person to each amount quoted. All fares and schedules are subject to CAB rules and regulations, send for additional details. Remember to send accommodations request to Flamingo Hotel. Send Advance Registration and information request to, SAROC, P.O. Box 73, Boulder City, Nevada, 89005.

73 magazine
for radio amateurs

$1.50
November 1972
26009



LETTERS

Thanks for the Advanced Class Study Guide with my new subscription to 73 magazine. I passed my Advanced Class License Exam in Houston, Texas, August 21, 1972 (just two days ago) by using this book and by using Advanced Handbook by Howard Pyle W70E (Howard W. Sams book). Both books are excellent study guides.

Ben W. Thomas

Six meter activity is rare around here, especially 6 CW. I decided to brave the TVI with a good LP filter, and try to build up 6 CW activity.

I'll only run 60w with a 6 element beam, until I see how the TVI is, with channel 2 only 25 miles away. Then, maybe more power if things work out.

I will welcome any skeds with anyone looking for Iowa on 6, CW preferred, but will also work AM.

Robert Lucas WAØDXZ
Iowa City IA

Recently I ordered parts for your current frequency counter project from your advertiser, Circuit Specialists. They do not carry some of the items, but because of my remote location, they shopped for me outside of their own store in order to send me the whole kit.

Any magazine with that kind of advertising just *has* to be something special!

Same goes for the advertiser . . . give them a discount rate!

Leonard C. Nelson KW6EG
Wake Island

First of all I would like to tell you how much I enjoy 73, and look forward to every issue. Please find enclosed payment for the next 2 years. The purpose of this letter is to point out something I read in your August 1972 issue covering the recent expedition to Navassa Island. The comment was made that KC4DX did not leave any signatures or such painted on rocks and buildings, which I'm sure they didn't. However, it was also stated that in 1958, KC4AF did not leave any signatures. Upon looking through some old CQ magazines trying to find another article, I ran across the June 1958 issue of CQ, and there on the front cover, as big as life, painted on the wall of Navassa Island, were the call letters W2NSD, which I have to assume were painted there during the KC4AF expedition. I did notice that on a similar picture of KC4DX that this wall had been painted black, or the picture painted over. Like I said in the beginning, I enjoy your magazine very much and this is not in the form of a complaint, only I do think an explanation is in order.

Keep up the good work, especially in WAØABI articles on the 50 MHz band.

Ted Hogan K4VAA
Cheraw SC

I was afraid that no one would ask. The fact is that rather than paint up the island, I chose the easy way out and painted up the photograph just for that cover picture on CQ. If you'll look closely at the picture, you'll see that I put in a shark swimming around the boat too. That was back when I was devious.

Wayne

I'm finally back in the land of infinite variety after a busy year at Harvard. Didn't get a chance to stop up and visit with you folks again so see you at the next Dayton convention if I get there.

About a year ago *The Milliwatt* announced two awards for the low power operator – DXCC QRPP and DXCC MILLIWATT for working 100 countries at the five and one watt power levels. Well, first QRPP DXCC goes to K4OCE for submitting proper QSL proof. I'm enclosing a photo of the award aptly displayed by my editorial assistant, Karen Thomas. We



still have announcement sheets for the awards upon request. I'm sure that the boys would appreciate getting an eyeball look at this DX award. If you can't use the photo, I'd appreciate getting it back. Keep plugging away up there old man. I envy you guys for your idyllic surroundings. These flatlands depress me something awful. But that's life, I guess.

Ade Weiss K8EEG/Ø
Vermillion SD

What? FLATLANDS? Maybe you should reevaluate your surroundings.

continued on page 246

SSTV continued

niche on the neck . . . if it shows where it was filed, it is soft. And I understand also, this varies in individual tubes – like some 5FP7's might be "soft" and some "hard." VK3LM has all the info if you're anxious to have a tube reworked.

Does a Slow Scan station equipped with a camera have a justifiable need for a flying spot scanner? This is one question Clarence K6IV and I discussed recently during a brief meeting. The advantages of a camera are obvious, but what are the advantages of a flying spot scanner? Possibly heat dissipation and pre-focusing. Although modern cameras perform quite well with a mediocre amount of light, this still adds to the heat produced in the shack. (How often do you duck out for some cool air, eh?) And, if you show a group of different pictures, a portion of time is required for refocusing, so photos and a FSS under certain conditions could prove worthwhile. One method of obtaining these results (for those of you with Slow Scan cameras) is by the use of a snap-on adapter. A minibox (or other suitable enclosure) can be fabricated so pictures will slide in one end. The other end is cut to fit over the camera lens, and securely fasten to the camera in a light, tight manner. Then a couple of small pilot lamps are added in the box, pointing toward the picture area. (The physical layout of a "photo end of an FSS" is covered fully in the SSTV Handbook if you don't understand my brief description.) Since this home-brewed adapter uses all your existing Slow Scan transmitting circuitry, nothing else need be taken off or added onto the camera, as desired. It is quite possible Robot may come out with an accessory like this in the future, if sufficient interest is generated.

I'm sure most of you recognize the chap in the photo as K6IV. Clarence transmitted this picture of himself to JA3JEW, and this is a photo of the received picture. Not bad for a California/Japan QSO, eh?

Color Slow Scan is on the upswing. If you are operating color, drop me a line on your progress, ideas, etc. I will add it in the column and possibly we can expand the color SSTV horizons in the near future.

Dave K4TWJ

73 magazine
for radio amateurs

#146 NOVEMBER 1972

THE COVER:
Henry Radio strikes back at last month's lovely cover girl with this picture of curvacious Myra Kotlar using the Tempo FNP transceiver — and loving it!

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3 SSTV Scene K4TWJ
4 AMSAT News WB8LBP
4 50 MHz Band ..... WAØABI
5 The Travelling Ham G3ZCZ/W3
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73 Magazine is published monthly by 73, Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas. $7 per year elsewhere. Two years $11 in U.S. and $12 overseas. Three years $15, and $16 overseas. Second class postage paid at Peterborough NH and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A. *Entire contents copyright 1972 by 73 Inc., Peterborough NH 03458.* *Phone: 603-924-3873.* *This issue of 73 started out like all the others — and then got away from us (obviously), turning out to be the biggest ham magazine ever produced in the western hemisphere. Readers have an obligation to sit down and write checks to as many advertisers as possible so they'll be back next month and we can bring you another whopper issue like this. The radio gear and parts will be a bonus to remind you of your support of a good cause. Reading time: 31 days.*



EDITORIAL BY WAYNE GREEN

THE NEW REGULATIONS
WAYNE'S VIEW

The heavy hand of an insensitive government has just dealt a cruel blow to the most exciting and fun aspect of amateur radio in many, many years. FM will never be the same.

It is sad to listen to the voices on the bands agreeing that, yes, the new rules do seem rather restrictive, but we can live with them. Sure, we can live with them. Man has shown himself to be eminently adaptable – able to live under almost any conditions, from Russian prison camps to the Inquisition.

But now, just as amateur radio has at last been staggering back from the blow of "incentive licensing," one of the last things we really need is to have a hysterectomy in the FM department.

THE GOOD PART

Many years late, the Commission has finally opened the 147 MHz segment of the two meter band to Techs. This move appears to have been purposely held up to try and sweeten the bitter pill of repeater restriction. It is the *only* major benefit from this otherwise negative and crushing report and order.

The other dim ray of light in the order was the relaxing of logging rules for repeaters. Much of the charm of this change was taken out by a reaffirmation of the need for detailed logging by everyone but repeaters. The Commission cannot, I believe, produce any substantial arguments to support the continuing of such logging. It is a hold over from the earliest days of radio and serves little purpose today.

THE BAD PART

The licensing of repeaters is now set up so that it is a great big deal just to apply for the license – and expensive. You have to have topographical maps to work out the average terrain – antenna radiation pattern charts, vertical and horizontal – diagrams of the entire repeater and control system (which has to be approved before each and every change) – provision for monitoring input and outputs of the repeater – a license for each and every control point – a license for the link – and a license for the repeater. At $9 per license, this can mount up rapidly.

Another disaster is the matter of monitoring. The new regulations are quite explicit in demanding continuous monitoring of the repeater input and output frequencies. This means that all but a few repeaters will have to be shut down when the control operators are asleep – when they are at work – on vacation – at the movies – playing cards – at a party – or (hopefully) with the wife. There doesn't seem to be any logical reason for this rule other than harassment and hamstringing of amateur repeater service since it is not difficult to provide safeguards which will shut down a repeater in the event of malfunction or funny business.

Let's take that to an extreme. Let's suppose that a berserk amateur has taken over the input of the repeater and is yelling porno and mayhem through the air – and he carries on for 24 hours straight before collapsing. A few of us with the patience to stick it out will have had something to talk about for years to come – the rest of us will have to use another repeater for a day. One or two sensitive souls may suffer a mental hernia from hearing such terrible things – providing they haven't ever been in a locker room or in the armed forces – or in college or high school during their lives. The rest of us will come out of it unscathed.

Direction finding gear being as it is, I doubt it will take very long to find the idiot. A recent case in New York hardly took any time at all before the repeater group was able to pinpoint the dingo who broke in on a repeater with hair-curling filth. Getting the FCC to do something about it was something else again, they seemed more entertained than alarmed.

The removal of the 220–222 MHz segment from repeater use blows the national agreed-upon plan for that band to bits. Pity, for the amateurs have displayed admirable cooperation in working out their own rules and allocations, complete with unofficial governing committees to keep everything in order. The FCC obviously was not impressed. The only logical reason that comes to mind for the shoving of repeaters out of the lower two MHz of the 220 band is to make room for the new citizens band which the Electronics Industry Association is buying for the Japanese.

The removal of repeaters from the 440–442 MHz segment of that band is another kick in the head. In view of the degree of organization that amateur groups have shown in the development of this band, it is difficult to understand this move. It serves little purpose and will be tremendously expensive to us.

Section 97,111c prohibits the crossbanding of repeaters. How come? There has been so little of this done that there is no way for it to have yet caused any problems. The two repeaters that I have used that had crossband facility (W1ALE in Concord NH and WA1KGO in Peterborough NH) never had any problems worthy of mention. Indeed, both provided a good deal of fun for those involved and made it possible for the six meter FMers to have a little window to talk with the two meter boys – and vice versa.

It is not practical to set up mobile FM gear for 52 MHz, 146 MHz, 220 MHz and 440 MHz all in one car. It is just too much. Too much investment – too much space – too much antennas – and too much to operate while driving. So what are we to do, have four different groups of amateurs using repeaters, with few ever able to talk with any of the other groups? Crossband repeaters with suitable controls are important, not only for fun, but particularly in times of emergency when it can be critical to be able to reach everyone.

Since repeaters are, under these new regulations, only permitted to operate in bands where all licenses above Novice are legal, there is no question of any operator being repeated out of his class of license.

I believe most amateurs will join me in thanking the Commission for finally opening up 147 MHz for Techs – for relaxing logging for repeaters – for permitting mobile control points for repeaters and remote base stations.

As for the rest of the regulations, they appear to be gratuitous harassment of the amateur service. They do not seem necessary. They are in some cases extremely harmful to the spirit of amateur radio. Little good can come from them.

ARTICLES NEEDED

While we do try and cover all bases in 73, the readership seems to prefer construction projects – particularly those using the newer ICs and transistors, so if you are building gear along

this line please keep in mind that many, many other amateurs would like to benefit by your experience.

By the way, when you send in diagrams using solid state devices, please be sure to include base diagrams to help those who will follow in your footsteps.

If your unit is of enough interest for a printed circuit board to be made available to the readers – or perhaps even a parts kit – we can arrange this with one of our advertisers unless you have sources of your own. Sometimes it is difficult to find all of the parts needed for a project, so we often try and work with an advertiser to make kits available.

If you are not sure about writing for 73, please send a stamped self-addressed envelope for *How to Write for 73.*

SAROC FM PROGRAM

As chairman of the FM program at Saroc, I am going to do my best to put on one whale of a show. It will be worth while coming to see, I guarantee.

The FM programs will start early on Friday morning and run all day Friday and all day Saturday until the big prize drawing Saturday afternoon. In addition to manufacturers on the spot to answer technical questions, there will be reports on FM activities around the country, an FM Symposium on changes we need in the FCC regulations – a report on the status of 220 MHz, and other topical subjects.

Representatives of repeater councils who will be at Saroc are hereby requested to drop a line to me so I can schedule you on the program. All of us want to know what has been happening in your area, so please bring a report. Repeater groups with slide shows or interesting FM oriented movies are also requested so let me know what you have available so I can schedule your part of the program and make arrangements for whatever equipment is needed.

FM will be the BIG deal at Saroc again this time, as it has for the last three years. Standard Communications is planning a lavish hospitality suite this time, complete with a built in Standard Repeater, of course. This custom has turned out to be a fabulous place for FMers to get together almost any time of the day or night to swap exaggerations about their repeater problems.

Several interesting technical papers will be read at the Symposium – and, if you have a paper that you would like to put on the docket, please let me know so I can get your talk scheduled.

The FM editors of all of the ham magazines will be present and will have their chance to say what they think of FM – and of Wayne Green, bless them.

It is likely that I will have a few words to say and that any lagging doubts as to why I am considered controversial will be settled once and for all. The fact is that I believe that a straight line is the shortest distance between two points, even if it bisects an advertiser or an ARRL official.

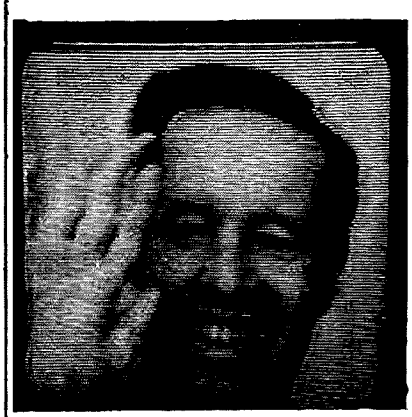
Saroc will run January 4th through 7th this time, with most of Thursday

continued next page

SSTV SCENE

Dave Ingram K4TWJ
Rte. 11 Box 499, Eastwood Vil. SON
Birmingham AL 35210

First off, Ralph WB8DQT, has some suggestions to supplement the photographic techniques I mentioned in the August column. If your camera is one that utlizes an electric eye for controlling the shutter speed, a piece of black electrical tape over the eye will automatically give you time exposures. Then all you need do is hold the shutter down 8 seconds. Also, you don't necessarily need to remove the yellow filter on the cathode ray tube. If your pictures are too dark, use the camera's color film settings of approximately ASA 75. Be sure to mark your settings after getting them right, so you will save time (and film) in the future.



Taggart also suggests using the popular SCR motor speed control units that are now available from most large department stores, to control light intensities on those camera flood lights. Usually these plug right in, so it should be super-quick, and sure beats fumbling with the camera's settings.

I understand that Mike W6MXV is developing a programmable MOS Memory unit. Slow Scan transmission capabilities without the aid of a camera or tape recorder. Probably he

continued next page

73 magazine
for radio amateurs

NOVEMBER 1972

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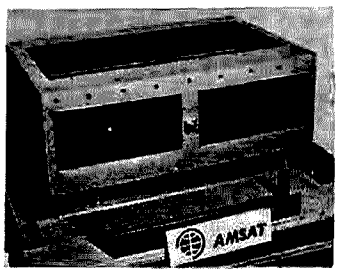
ARRL & FM

The League is showing an increased (if belated) interest in FM and was represented at the recent FM Symposium (hosted by 73) by W1ICP, who was most helpful with suggestions and ideas.

More on the symposium on page 281 . . .

AMSAT NEWS

Mike Frye WB8LBP
640 Dauville Dr.
Dayton OH 45429



OSCAR 6 launch date October 11.

From all the reports I have been receiving, A-O-C is progressing at a good rate. Launch preparations are progressing smoothly and to my knowledge the launch is on for late October.

I have been getting a good response from amateurs all over the country. Although many still seem unclear as to the exact uses of the satellite. The ten to two meter repeater will accept *any* form of transmission – this of course includes FM. However, the repeater operates most efficiently on CW, SSB, and AM respectively.

The estimated area that can be utilized through the satellite is easy to determine. Simply draw a circle from your location with a radius of 5000 miles. This should give you an idea of the countries you should be able to work.

A-O-C provides for DX every day. Information I have received from John Gregory W3ATE indicates that the satellite should be in the local area at 7, 9 and 11 a.m. and p.m. for about 25 minutes each duration. Length of the duration depends on your latitude. Twenty-five minutes is a good estimate for the latitude through Pennsylvania, Ohio, etc. The greater your latitude the longer the duration of the signal. If you were to live on the upper edges of Canada you would receive almost three hours of continuous use twice a day! *WB8LBP*

50 MHz BAND

Biff Turner WAØABI
Five Chestnut Court
St. Peters MO 63376

The band continued opening through early September, while not as frequently as earlier, it provided many excellent contacts. Conditions and activity during the ARRL contest were good-to-excellent for this time of year. Groundwave during the first two weeks of September was exceptionally good with contacts to 500 miles commonplace. TV signals were noted on all (VHF) channels on a number of occasions. During the early morning hours of September 2, WTWO Indianapolis, was received for several hours with signals as strong as the local channel 2. Numerous calls on 6 brought no reply.

Six meters is in the midst of a period of rapid growth in the St. Louis area. In the past six weeks WAØRQH, KØYYV, KØRWV, KØWYN, WB9JGR and K9YNN have become active for the first time on SSB; in addition WØWEQ, KØRMF and WØAJQ have returned after periods of inactivity

Terry WA4WDU, and John WB2VNI/5, are increasingly active from Memphis. WB4HEL/4, also from Tennessee, was heard almost constantly during the contest. WA5SJM, Marked Tree, Arkansas, is active on a daily basis on CW and SSB.

The annual conference of the Central States VHF Society was an interesting 3 days for the serious VHF crowd. Items of special interest to the 6 meter group were tape recordings of the first (CW) moonbounce contact between K5WVX and WA5HNK, tapes and slides from the VP5RS DXpedition presented by WW4GDS and WB4BND, and Dr. D. E. Olson of the University of Minnesota Physics Department presented a most interesting talk on the subject of magnetic storms. On the lighter side, W1HDQ, "Mr. VHF," recounted the virtues of 2 meter FM to what is without a doubt the largest gathering of knowledgeable VHF/UHF people anywhere. Among the 6 meter group in attendance were K8LEE, WA8PEB, WAØVJF, WBØBBC, WØGNS, KØLCB, KØTLM, WAØTXV, WA7FPO, W7EN, VE4MA, W5WAX and WØPEP.

WB4WNV asks some questions on behalf of four hams in his area, the answers to which might be helpful to others. It is easy to get in the habit of assuming all readers have 6 meter experience. Lowell's letter reminds me

W2NSD/1 continued

talk from one end of Circus-Circus to the other – get rides from one casino to another via cruising FM mobiles – the 4th spent meeting and setting up the exhibits. On Friday everything gets going bright and early as the last arrivals drive in from California – the exhibits are going all day – the FM Symposium will be going strong – and that evening a couple of thousand amateurs spread out all over Las Vegas, handy-talkies in hand, to see what mischief they can manage. They make a few rolls at the tables – hit the slots – and end up in the Standard FM Hospitality room to lie a lot.

Things are in high gear on Saturday too until the big prizes are given away in the late afternoon. After a short rest everyone is ready to get out to see the extravaganzas up and down the strip. If you monitor 94 you will hear something akin to CB channel 10. You may hear one chap asking another to pass the salt to the other end of his table – or, after a few drinks, you may hear almost anything. And what about the chap, who had better remain nameless, who put his hand unit down so it stuck on and broadcast every intimate detail of a most interesting contact? I understand tapes are available.

Work Saroc into your schedule this time – it'll be fun.

My plans are to stop up at Aspen on the way back for a few days on the skis. Anyone else interested?

. . . *Wayne*

SSTV continued

will make this available on P.C. boards, like the W6MXV monitor. Incidentally if you have a chance to see this monitor or the J & R Electronics MXV 100 (similar circuitry with some additional goodies), don't pass it up. This one really comes on strong and the pictures are great. Watch for my upcoming reports on these units in 73 for full technical details.

Asia is again being represented on Slow Scan by a few 4X4's. I really can't describe the thrill of seeing those boys identifying with Israeli writing on the screen, but it surpasses even the best DX audio QSO's. Watch for them on 14.230 kHz around 0000 GMT. Also, you might watch for ON4CZ, VP2ME or 8R1W, some of the newer hams to join the SSTV ranks. I understand also that the U.S.S. Hope is on SSTV, but I don't know their call. And watch those VK3's on SSTV. They recently formed the Eastern Mountain Radio Club (for SSTV) and are really coming on strong. You will probably be hearing quite a bit about the special P26 Phosphor they have come up with especially for SSTV use. This is a real beauty and can be viewed in any light; even daylight. I understand they can re-gun and re-phosphor (no splitting – they do both or no deal) any cathode ray tube with a "soft envelope." They determine if a crt is "soft" envelope by filing (carefully) a

continued on page 14

THE TRAVELLING HAM

Joe Kasser G3ZCZ/W3
1110 Fidler Lane, Apt. 1610
Silver Spring MD 20910

Connecting a rig up to the ac line overseas can pose problems. In fact, connecting anything American causes a potential problem, be it a rig, an electronic flash gun, or anything requiring a recharge of internal batteries.

Just because you have a plug that fits the wall socket does not mean that you can connect the plug to the line cord and plug it in. It is first necessary to determine the value of the local line voltage, as described last time. Then knowing the requirements of the rig, something can be arranged. If the rig does not have multi-voltage line input facilities (like an FT 101) then a transformer will be needed.

If you wish to buy one, ac transformers for dropping 220 volts down to 110 volts can be obtained at Lafayette and other places, suitable for use at powers of up to one and a half kilowatts, more than enough to run any rig barefoot. These transformers can be home-brewed by connecting plate transformers up in reverse, that is, by plugging the secondary into the ac line and the primary into the rig. Turns can be added or removed from the secondary to make almost any hefty ex-TV transformer suitable. The only thing to watch is that overseas, power line frequences are usually 50 Hz, which means that the transformers used over there require more core area than if used stateside. If the transformer is not used under full load conditions that requirement should not bother the travelling ham.

When winding or unwinding turns, the transformer can be tested by running it in reverse. That is, by plugging the primary into the ac line and measuring the voltage at the secondary. When fiddling with the turns, aim at a value around 230 volts.

When you are satisfied with the voltage ratio, tidy up the loose windings. Use lots of masking tape or similar stuff. Next connect a female ac line connector to the 110 volt side. A heavy duty drugstore ac adaptor is just the thing. Leave as much cord in the line as possible. Then connect some cord to the 230 volt side and leave the ends bare. When overseas, obtain a local line connector. A connector can usually be borrowed from a nearby appliance – the trusty screwdriver strikes again!

If you are not taking an antenna with you, or are unable to get one up, a unit such as a Johnson Matchbox and an swr bridge is a must. With those devices you can load up bedsprings, window frames or long thin wires. You may not work any exotic DX, but you will put out a signal and work something on the HF bands. Being an avid VHF'er I recommend VHF for working the locals, but the HF bands have their place in enabling contact to be kept with home while in far-off lands.

G3ZCZ

INTERESTING FREQUENCIES

SSTV	QRPP
3845	3540
7220	7040
14230	14040
21340	21040
28680	28040

that this is not the case. *Q. "Is the TVI problem as bad with SSB as it is with AM? It would seem not, due to the absence of a carrier."* A. The lack of carrier does little to reduce interference. SSB produces RF as you talk, giving the TV viewer the opportunity to watch between words and sentences. I have found they will seldom settle for a shared time status. Probably the greatest reason for TVI reduction is heterodyning rather than multiplying to the output frequency. This minimizes the change of oscillator harmonics falling in a TV channel. The average AM transmitter uses 8 MHz crystals multiplied by 6; if you were operating on 50.400, an 8.4 MHz crystal would be used. The seventh harmonic would fall in channel 2, the eighth in channel 4, etc. In a well-designed SSB rig the only harmonic you need normally worry about is the fourth of your output frequency which falls in one of the high VHF channels. This is not difficult to trap out if the need arises. The major TVI problem with SSB is fundamental overload. This may be cured in most cases by the installation of a GOOD high pass filter on the TUNER of the affected TV. Most manufacturers supply these free on request. By the way, don't believe the old wives' tale to the effect that you can't understand an SSB transmitter on a TV or Hi-Fi, nothing could be further from the truth! *Q. "What frequencies are commonly used in this part of the country?"* A. 50.110 MHz has become the calling frequency for most of the world, only in areas where this frequency is not assigned to the amateur service is activity greatly removed from 50.150 ± 50 kHz.

WAØABI

MARS

Harry Simpson A4SCF
P.O. Box 27015
Memphis TN 38127

Several months ago when this column was visualized, it was intended to be a sort of clearinghouse for MARS information – a column designed primarily to inform MARS members in one area of happenings elsewhere. Many telephone calls were made, many letters written and scores of personal friends were contacted, requesting information that would be of general interest to the entire MARS membership.

After the first effort appeared in the May, 1972 issue of *73* Magazine, it became apparent that most MARS members are already well informed, and that the column was of more interest and benefit to non-MARS members. That change in direction was all right with the author – since his feelings for the MARS program border on the apostolic! After more than twenty years as an active member of Third US Army MARS it could hardly be otherwise.

You see, in spite of propaganda from other sources, MARS is unique in that it exists solely as a result of the efforts of thousands of dedicated individuals. Reactionary and bureaucratic conditions are not allowed to exist – on the contrary, MARS is progressive and innovative! Whatever the field or interest MARS members are numbered among the leaders. Suggestions for the betterment of the program are welcomed, quickly evaluated and just as quickly placed into effect if worthwhile. No Board of Directors, No General Manager – just pleasant, efficient communications at its most enjoyable best!

Your response during the past six months has been, to say the least, terrific! Last month alone, over two hundred letters were answered. The writer has an aversion to form letters, feeling that those who took their time to write deserve nothing less than a personal answer; however, due to the massive influx of correspondence, the only solution was to mail a MARS brochure and trust that all questions were answered thusly.

A suggestion – if you would like to become involved in MARS and do not know any MARS members – attend your local ham club meeting and let it be known that you would like to become a member of MARS. It probably won't take more than a couple of minutes to make your first contact.

HOT GEAR

This gear was stolen on August 23, 1972: Swan 270B, Ser. No. M-395430, hand-held microphone for above, model No. 404, with groove filed in P.T.T. switch to lock in talk position. Contact Jeff Lackey W8HST, 7760 Willis Road, Ypsilanti, Mich. 48197.

Roger WA1NVC has had his HR-2A lifted from his car in Somerville MA. If you know anything about the whereabouts of Roger's rig (Ser. No. 04-07152) please let him know. Most ham gear looks like CB equipment to thieves; and there is a big market for CB gear. Please take the proper precautions with your rig.

List from Past Issues:

Mfr., Model, Ser. No.	Owner	Issue
Yaesu FT-101 No. 107036	WA2YSW	4/72
Standard 2m FM No. 102703	W6NPV	4/72
Drake ML2 No. 20189	WB2LLR	4/72
Standard SRC-806M No. 009210	K1TLP	5/72
Aerotone 6M 355LT, No. 685064	RR Police Grd.Ctrl.Trml. NYC	5/72
Standard SRC-806M, No. 102703	C. Mathias 3234 Coronado Ave Imperial Beach CA	5/72
Lafayette HA-410 No. 009210	WA2KDG	5/72
Coll., 62S1 No. 10728	MSU ARC E.Lansing MI	6/72
WRL Duo-Bndr 6010AT302	WA6FCY	6/72
HR-2A, 11 chan., 04-07152	WA1NVC	9/72
Swan Cygnet 270,No. 313022	K4ACJ	9/72
Collins Mic, Mod. MMs, No. 4294	K4ACJ	9/72
Heath HW-100 & AC PS	WA2JGP	10/72

On the other hand, if you reside in an isolated area with no ham club, you are just as important and welcome. In such a case, if you live in the East write MARS Director First Army, Ft. George Meade, MD; in the Southeast write MARS Director Third Army, Ft. McPherson, GA; in the Mid- and Southwest write MARS Director Fifth Army, Ft. Sam Houston TX; in the West and Northwest write MARS Director Sixth Army, Presidio, San Francisco, CA. They will gladly furnish information concerning your entry into the MARS program.

Sincere thanks to all who have helped this effort with information and/or moral support – to Wayne Green for the soapbox, to Col. Woodside in Washington, Jim Cooper in New Jersey, Hal Mulkey in Atlanta, "Andy" Anderson in Rome, "Doc" Klotz in Memphis, Bill and Margaret Pearre in Houston, Russ and Lucille Peck in Oregon and Maurie Schmitz in Hollywood – to name a few.

If even one amateur has found his niche – a new and exciting way of life in the MARS program, then these hours shall not have been spent in vain!

A4SCF

Microwaves

Jim Weir WB6BHI
Box 23233
San Diego CA 92123

Nice letter and enclosure from Bill Turner (WAØABI). It seems Bill works in the Gallium Arsenide facility (that's the Gunn and Impatt diode material – GaAs) of Monsanto Chemical in St. Louis, and found a few *hundred* surplus GaAs diodes in the microwave package. Unfortunately the diodes had been used in a destructive life test, and were 75% shorted and 25% open. Oh, well, Bill had good intentions of supplying all you microwave cats out there with free diodes. Sorry it didn't work out. How about some inputs from you other people in the industry.

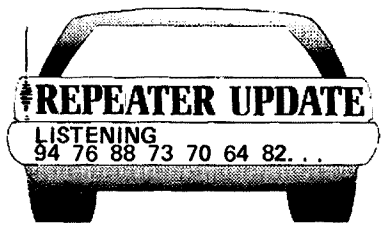
An item in one of the trade magazines notes that the FCC has purchased a mobile van to study "crowding conditions" in the bands 25–512 MHz. A computer controlled spectrum analyzer will sample specific signals and note the time usage of each frequency in this band. Why no study of the microwave bands? Simply because there is no crowding in the bands above 1 GHz. For instance, above amateur "1" band (1215 MHz) there is more spectrum space in this band than in *all of the lower bands* combined. The same statement holds true for all higher bands. Each higher band contains more space (spectrum width) than all the bands below it combined.

An interesting sidelight of the above discussion for those of you interested in the "ultimate" antenna location for the dc bands; put your 20-acre rhombic for 160 meters, your 500 foot mast and 15 element beam for 80/10 meters, and all the other antennas you need for all bands through 2 meters up on the 5000 foot hill, and beam all signals on *all* bands (not just the amateur bands) through 150 MHz down to your house on amateur "s" band. Yes, you will have a full 150 MHz bandwidth from 2300–2450 MHz.

Or, for those of you interested in ATV, you could put 20 fast-scan TV signals with 4 MHz (broadcast quality) bandwidth in amateur "1" band with enough space left over to put all the amateur signals from 160 through 6 meters in simultaneously.

Let's hear from those of you who are using the amateur microwave bands – your fellow amateurs will benefit from your experience.

WB6BHI



NC	WB4QGE	Winston-Salem	25–85
OH	K8ALB	Toledo	10–70 01–61
OH	WB8CQO	Toledo	34–94 20–80
TX	WA5GRE	Amarillo	34–94 444.5–449.5
TX	W5CBT	Amarillo (Delete)	
TX	WB5EMR	Levelland	28–88
TX	(no call)	Perryton	34–94
CANADA			
Manitoba			
	VE4BDN	Brandon	46–94

CALIFORNIA ACTS!

The repeater groups of Southern California gathered on September 9th for an FM symposium. Approximately one hundred attended the conference, representing over 40 repeaters. The result was an agreement (with but one nay) to adopt the 600 kHz plan.

The meeting was moderated by Skip Clark WB6TXX. It was co-hosted by the Edgewood ARS and the Pallisades ARC and the chairman was John Griggs W6KW.

The result of the scramble for standard channels at the end of the meeting was this:

01–61	WB6ZDI (PARC)
04–64	WB6WLV
07–67	WA6FLH
10–70	WA6TIC (RTTY)
13–73	W6IN, WB6RSK
16–76	WA6ZZR, WB6SLC, W6ZGC
19–79	K6SYU
22–82	W6FNO, WB6TSO, K6ZXZ
25–85	WA6ALV, WB6IWF
28–88	WA6SIN, K6QEH, WA6ZYN
31–91	WB6VQD
34–94	WB6GUA + simplex
37–97	WA6ZZE, WB6SZO
147.42–146.40	WA6TDD
147.60–00	WA6IRY
147.63–03	W6GY
147.66–06	W6IWY
147.69–09	WA6TWF
147.72–12	W6QFK, WB6VMV
147.75–15	W6AOE
147.78–18	WA6VFO
147.81–21	WB6GGL
147.84–24	K6MYK
147.87–27	K6SIR, K6CPT
147.90–30	WA6PPS
147.93–33	WA6KSB
147.96–36	K6YDQ/K6VGP
147.99–39	WA6FLL (FAX)

FIRST BERMUDA REPEATER

The first two meter repeater on Bermuda is going on 34–94. This will be VP9BDA and, after getting checked out, will be set up on the lighthouse. It will cover the entire island. Remember to bring your handy-talkies when you go to Bermuda. Geting a license is simplicity – you get in touch with VP9EP, the Wireless Inspector (in the phone book) and he will get you set up. You'll get your own call/portable VP9. A visit to Bermuda is about 800% more fun when you get to meet and talk with the local amateurs – they are really great guys. 94-simplex fanatics may not be welcome.

NEW ENGLAND COORDINATOR 220 MHz BAND PLAN

The frequency coordinating team of K1KEC, K4GGI/1 and F2BO/W1 got together on the air the other evening to work out a new scheme for repeater occupation of the 220 MHz band in case the FCC is resistant to all requests to change their minds about cutting out the lower two MHz of the band.

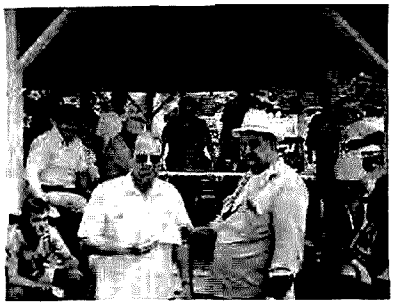
The previously agreed upon 3 MHz split between repeater inputs and outputs will be changed to 1.6 MHz and the simplex channel will be 223.5 MHz.

Inputs	Outputs	Inputs	Outputs
224.98	223.38		
224.94	223.34	224.42	222.82
224.90	223.30	224.38	222.78
224.86	223.26	224.34	222.74
224.82	223.22	224.30	222.70
224.78	223.18	224.26	222.66
224.74	223.14	224.22	222.62
224.70	223.10	224.18	222.58
224.66	223.06	224.14	222.54
224.62	223.02	224.10	222.50
224.58	222.98	224.06	222.46
224.54	222.94	224.02	222.42
224.50	222.90	223.98	222.38
224.46	222.86	223.94	222.34

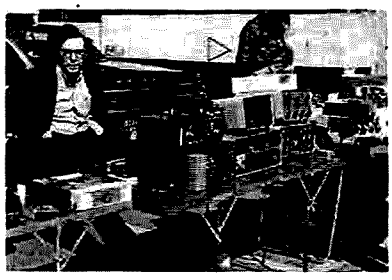
The frequencies 222.3 and below are reserved for the time being for present occupants of the band such as AM, sideband, CW, etc.



AKIRA KOBAYASI JA2AMD in his shack.



Look who was smiled upon by the Fates at the Six Meter Club of Chicago Picnic and Hamfest last August. Winning a year's subscription to 73 is Don K9TZZ on the left. Jack K9ZWU looks like he is a bit reluctant to let go of the prize . . . he must recognize the true value.







Some pictures taken at the Dayton Hamvention flea market. You missed it? Too bad!

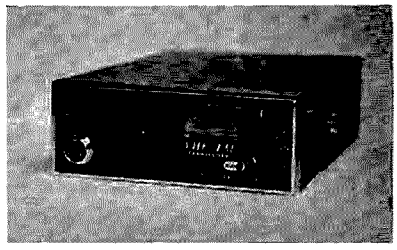
INDIA ACTIVE ON SSTV

The first U.S. contact for VU25KV on slow scan was W6KZL. Glen is right in there pitching – and was the only six to make it to Navassa. He also makes a speciality of working as many countries from his car as possible and is now up to 251 – probably the mobile record.

KH6HJF has been putting his slow scan camera to a telescope. This is not only remarkable for views of the moon and the sun spots, but he has been able to transmit ½ in. letters clearly 83 ft from the camera!

NEW PRODUCTS

NEW TEMPO 220



While several of the manufacturers have been firming up their 220 MHz transceiver designs, Henry Radio has been spurring their Japanese supplier to provide a unit. It looks as if Henry will be the first one to be able to supply the 220 rigs in quantity.

Two samples of the New Tempo 220 were checked out at 73 and run through their paces. We must say congratulations to Ted Henry for getting these designed, manufactured and imported.

The rig is similar to the two meter FM rigs, but is deluxe all the way. It has all sorts of nice features. The twelve position channel switch is back lighted so you can easily see the numbers in the car at night – and the numbers are big enough for middle-aged hams to read without getting out their glasses. The power on-off switch is separate so you don't louse up either your volume or squelch settings every time you turn the rig off. The hi-lo power switch will no doubt stay in the 10 watt high power position when the rig is used in the car or at home, but the 3 watt position may be just what you want if you add a little nicad battery pack to this for shoulder use. The low battery drain makes it a natural for this – only 150 mA on standby and 250 mA on receive. It draws 2.8 amps on high power transmit

The receiver has plenty of poop (2 watts) to drive your car speaker – and there is a jack on the back of the rig to plug in the external speaker (this mutes the built in speaker).

This may be the first FM rig to have an S-meter which also doubles as a deviation meter! There is a switch to provide this function. On transmit the meter shows power output. The final is protected in case you forget to put on the antenna – or it happens to short out.

Both the transmit crystals and the receive crystals have warping capacitors. Less deluxe rigs save the cost of those receive capacitors. The warping

continued on page 12



NEW PRODUCTS

100 WATTS SOLID STATE LINEAR!

It looks like solid state has finally hurdled the last barrier toward its conquest of the vacuum tube. TRW has announced that it is manufacturing a new line of RF power transistors designed for HF linear applications. Designated PT5740, PT5741 and PT5742, they will deliver 15, 30 and 60 watts output respectively when powered by a 12 volt source. They are brutes! In typical linear installations they will withstand a wide range of bias and temperature conditions. They are impervious to load variations as extreme as an open line or a complete short. Compromising protection and compensating circuitry is not required in most cases because of the unique TRW design. Intermodulation distortion products are claimed to be better than −30 dB and collector efficiency averages about 45% in SSB service.

True portability is here. No more big tubes, transformers or separate HV supplies for fixed and mobile operation. From now on the output stage

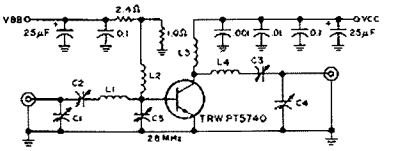
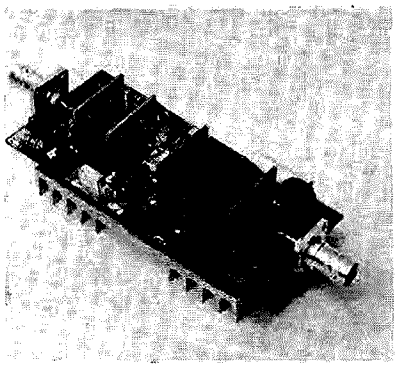


Fig. 1. 10 meter 15 watt amplifier.

C1,	ARCO No.467, 110-580 pF
C2,3,4,	ARCO No.466, 80-480 pF
C5	ARCO No.469, 170-780 pF
L2,3	10 TURNS No.18 AWG, 0.5" MEAN DIAMETER
L1,4	5 TURNS No.14 T.C., 0.5" MEAN DIAMETER, L1 EQUALS 1.0"
V_{cc}	12.5 VOLTS
B_{bb}	1.6 VOLTS (IC [QUIES] = 25mA)



25 Watt solid state linear amplifier

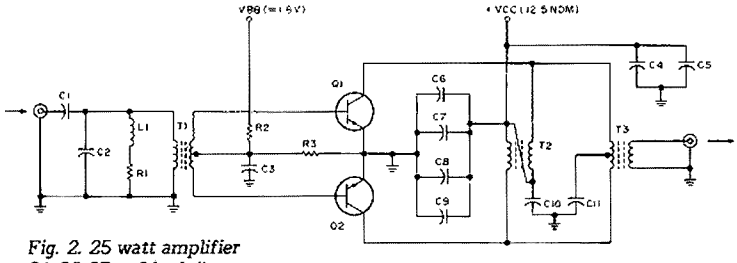


Fig. 2. 25 watt amplifier

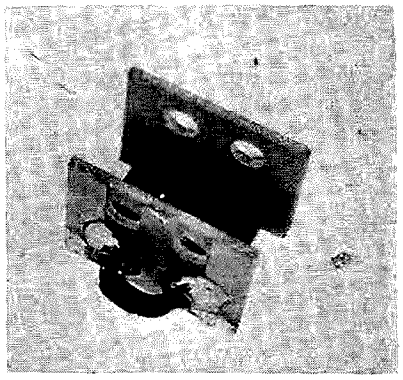
C1,C6,C7	.01 μf disc
C2	56 pf dipped mica
C3,C10	Unelco 1000 pf
C4,C11	.1 μf disc
C5	25 μf 35V
C8,C9	.001 μf disc
L1	1.5 μh molded
R1	56Ω 1/2 W carbon
R2,R3	1Ω 1/2 W carbon
T1,T2,T3	See Text
Q1,Q2	TRW PT5740

can be as compact as the rest of an SSB rig. Take a look at Fig. 1 and see how simple it is to get 15 watts SSB out of a transistor. With careful placement everything would probably take up less space than an average filament transformer.

25 Watt Amplifier

Figure 2 is a 25 watt amplifier using two PT5740's push-pull class AB. It will operate anywhere in the HF spectrum from 1.5 to 30 MHz without the need for bandswitching. Broadband switching gets pretty complicated when matching low impedances and a broadband arrangement simplifies things considerably. It will amplify anything fed into it, so a clean driving signal is a must. Harmonic suppression also suffers because of the non-resonant output. This is not too much of a bother because the even order harmonics are cancelled fairly well by the push-pull configuration. The odd order harmonics need not be troublesome if care is taken to make sure that the antenna system is Hi-Q and resonant. Or use a filter.

The transformers are interesting and they deserve a bit of discussion. The center tapped winding on T1 and T3 consist of two pieces of .190" brass tubing mounted between two PC board end plates. On one end plate the tubing is soldered together for the center tap. The other winding consists of a single wire wound through both tubes. The tube length for T1 is .80"



Details of transformer T1.

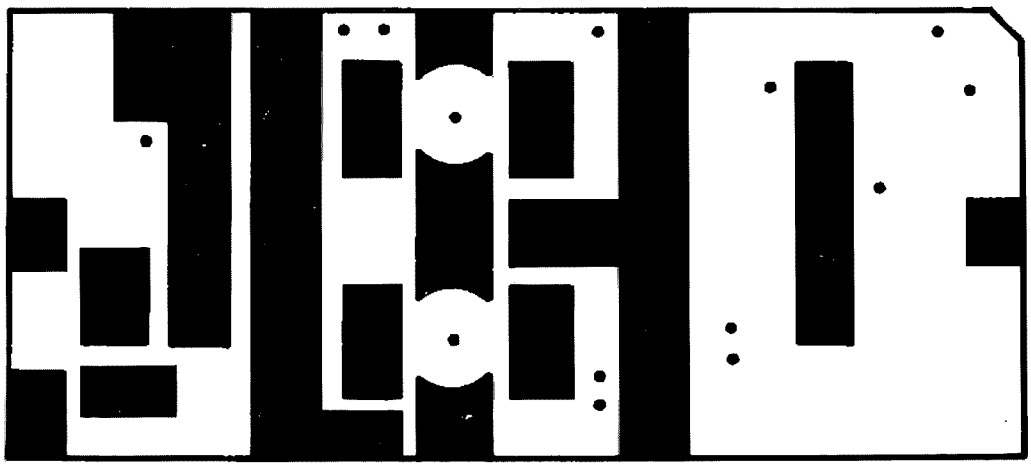
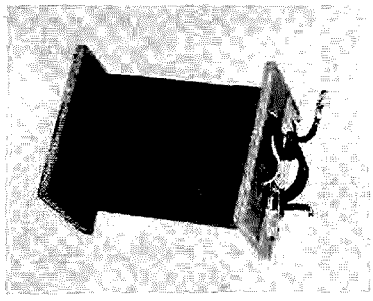


Fig. 3. Full size P.C. board for 25 watt amplifier.



T2 and T3, T2 is at the top.

and the wire winding is 4 turns No. 20 enameled. The tubes for T3 are 1.375" long and the wire winding is 3 turns No. 20 enameled. Large ferrite beads are slipped over the length of each brass tube before final assembly. T2 is mounted between the same end plates as T3 but consists of a twisted pair of No. 18 enameled wire run through both stacks of ferrite beads once (no tubing used). The photographs give details on the transformer construction.

This amplifier is perfect for an ultra-compact low power portable transceiver. With intelligent use of IC's and miniature components, it should be possible to build an all-band SSB rig about the size of the FM rigs currently on the market. A high-low power switch could be easily incorporated to make battery operation possible when no sizable amount of power is near.

100 Watt Amplifier

While a 100 watt amplifier could be constructed using only two of the higher power PT5742's, difficulty arises in trying to achieve the ex-

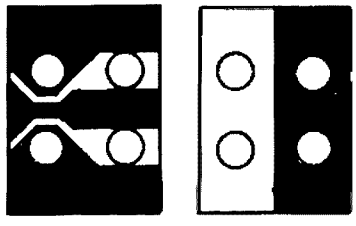


Fig. 4. Full size transformer end plates.

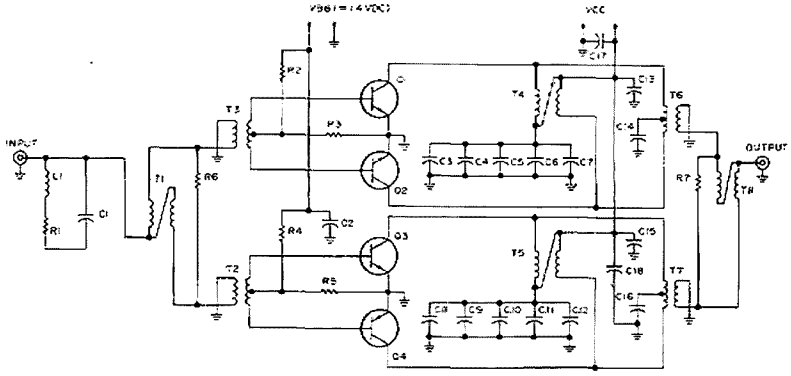


Fig. 5. 100 watt amplifier.

C1	62 pf dipped mica
C2 13,15	Unelco 1000 mmf
C3,8,14,16	1 μf 50 v disc
C4,5,9,10	.01 μf 50v disc
C6,7,11,12	.001 μf 50v disc
C17,18	25 μf 35v electrolytic
L1	2.2 μh molded inductor
R1,6	100Ω 1/2w carbon
R2,3,4,5	1.0Ω 1/2 w carbon
R7	100Ω 2w carbon
Q1--Q4	TRW PT5741
T1,8,4,5	Identical to 25 w T2. T1,8 are not mounted on P.C. end plates.
T2,3	Identical to 25 w T1 except wire winding is 5T No. 18.
T6,7	Identical to 25 w T3 except wire winding is 4T No. 18
NOTE:	Tr--T6 and T5--T7 are mounted on the same P.C. end plates like the 25 w T2--T3 pair.

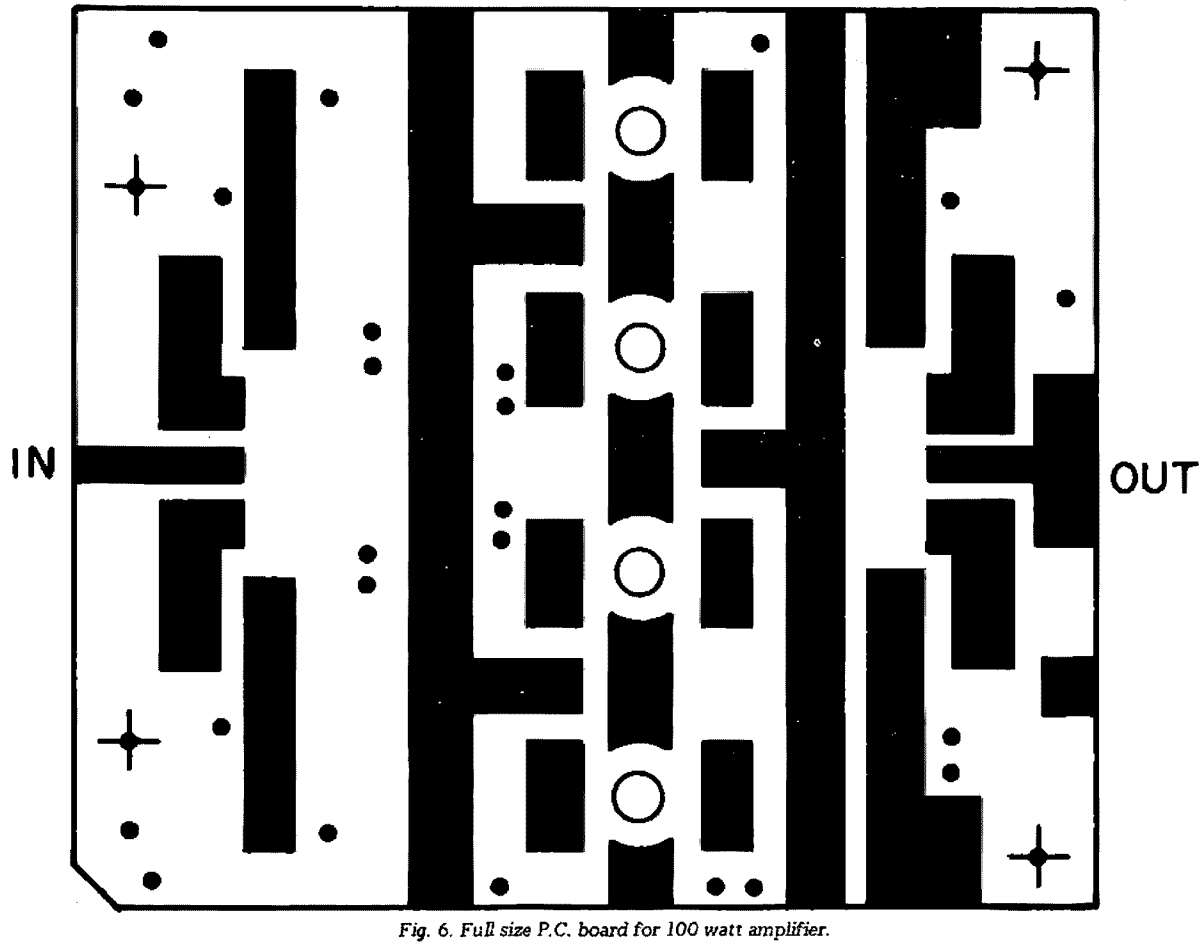


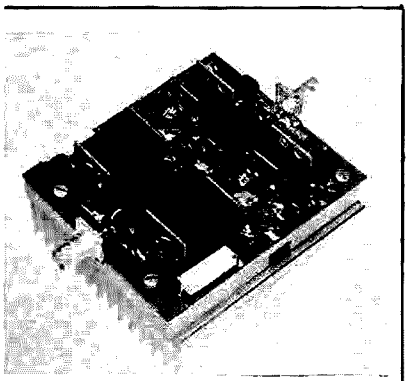
Fig. 6. Full size P.C. board for 100 watt amplifier.

capacitors are very easy to get to, by the way. We say that in memory of an earlier rig or two where you had one hell of a time getting your crystals on channel.

The front panel is right up to date — black with green back lighting on the channel switch and meter. There is a little light that comes on when the squelch operates and we suspect that not a few amateurs will be using this for an emergency carrier operated relay. This rig looks as if it could be converted into a repeater very easily. The modules are all separate and relatively well shielded from each other.

We set one unit up on top of nearby 73 mountain and drove around with the other in the Rover, with a trunk mount Hustler 220 antenna (5/8 wave, of course). Frankly we couldn't see much difference in the coverage between the 220 rig and a ten watt 146 MHz rig. They both held up about the same and started falling off about the same. There seemed to be a few more hot spots where the 220 rig would peak up than on 146 once we were in a shadow area, but the difference wasn't remarkable.

The price is not firm on this new rig yet, but it is expected to run under $350. It would make a fantastic package at that price.



100 Watt solid state linear amplifier

tremely low load impedance they require over the full range of 1.5 to 30 MHz. Thus they are more suited to limited bandwidth applications. The four PT5741's used here require a slightly higher load impedance than the PT5742's which makes broadbanding the circuit a bit easier. The 100 watt amplifier in Fig. 5 is essentially two 50 watt push-pull amplifiers that are fed in phase with each other through T1. Each output is combined in T8 and 100 watts overall is fed into the antenna. Any amplitude or phase unbalance is absorbed by R6 and R7.

This amplifier is designed to be driven by the 25 watt amplifier running class A. A slight bias adjustment will do this and the power falls to 5 clean watts which is the proper amount to drive the 100 watt amplifier to full output.

These two amplifiers are perfect for an all-band all solid state rig. They could both be incorporated into a small transceiver, or the higher power amplifier could be left forever in the trunk of your car to be powered by the miniature 25 watt rig that you store away in the glove compartment.

The two PT5740's and 30 ferrite beads needed to construct the 25 watt amplifier are available for $36.00 as Kit #PKT 3104 and the four PT5741's and 84 ferrite beads for the 100 watt amplifier are available for $112.00 as Kit #PKT 3103, from *Ham Radio Center, 8342 Olive Blvd., St. Louis MO 63132.*

MARK XII REGULATED SUPPLY

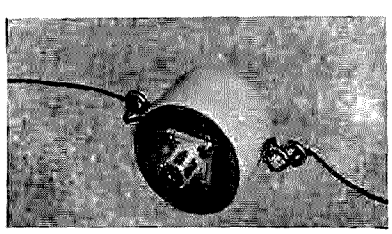


It probably has not totally escaped you that most of the equipment today is designed to run with a twelve volt supply. If you live in a car this is probably fine. If you want to use the gear at home then you have to come up with twelve volts.

The Mark XII people are not insensitive to your problems and desires. Their new 3A power supply has a voltage reulator built in which puts a lid on the voltage, holding it down to about 14 volts with no load. This is low enough so it should not cause any problems on low-current applications. An unregulated supply could pop your receiver or converter by swinging up to about 16 volts with a light load.

At $24.95 this is not a bad bargain to have around for running those gadgets which don't need much more than 3A maximum.

NEW HF BALUN



Palomar Engineers announces a new 1:1 Balun. It matches 50 or 75Ω coaxial cable to center-fed dipole or inverted Vee antennas. By preventing radiation from the coax it improves antenna radiation pattern, reduces noise on receive, and helps prevent TVI, BCI, and rf feedback within the station.

The Balun transformer is wound on a large ferrite toroid core and handles a full kilowatt power from 1.7 to 30 MHz. The transformer is enclosed in a white plastic housing and is completely encapsulated to prevent moisture from entering. All hardware is stainless steel.

Eye bolts on the sides allow the Balun to replace the center insulator of the antenna and an eye bolt on top can be used to support the antenna. The Balun is a compact 2¼ in. diameter and 2 in. high. It is priced at $12.95 postpaid in U.S. and Canada (plus 5% tax in California). Write to *Palomar Engineers, Box 455, Escondido CA 92025* for a descriptive brochure.

FM ANTENNA MOUNT



A new mobile antenna mount that features fewer parts, simplified and quicker installation, lower silhouette and positive weather protection has just been introduced by Larsen Electronics. Designed to go into the usual ¾ in. hole, the mount is adaptable to any location on roof, fender, trunk, etc. Only three parts are involved and no special tools are required for installation.

The mount will accommodate either soldered or solderless fastening of coax according to the desires of the installer. A case hardened steel flange assures positive grip and ground connection to the vehicle. It will fit any antenna that requires a 5/16 by 24 thread and when used with the Larsen LM Antenna provides a low, low silhouette and thread to thread connection for greatest electrical efficiency. It also provides an installation that permits quick and easy removal of the antenna when the car goes through mechnical car washing facilities.

To install the Larsen mount one has only to attach the coax (step-by-step full scale illustrated instructions are included) and feed it to the equip-

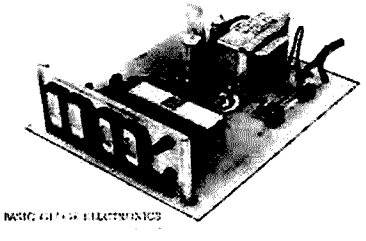
ment. The under part of the mount goes easily through the ¾ in. hole and a tough plastic fitting and weather-proofing "O" ring spins into place. With those three steps the mount is ready to receive the antenna. For more details, write to *Larsen Electronics, Inc., P.O. Box 1686, Vancouver WA 98663.*

PORTABLE FM ANTENNA



A new industrial type, continuously loaded VHF portable antenna, Model HM-5, has been added to Antenna Specialists high performance amateur line. Designed to withstand the rough handling that makes telescopics impractical, the new spring antenna is completely insulated and cannot accidentally be shorted out. It features a connector fitting that attaches directly to portable equipment with SO-239 connectors. Power rating is 25W with nominal input impedance of 50Ω. A companion model, HM-4, is identical except for a standard 5/16" – 32 threaded male mounting base. Both antennas are available from amateur distributors at a suggested ham net price of $5.95. For additional specifications, write to *Amateur Department, The Antenna Specialists Company, 12435 Euclid Avenue, Cleveland OH 44106.*

DIGITAL TIME



Ever since the first digital clocks came on the market, probably 30 years or so ago, we've been fascinated by them. And when the nixie readout clock became practical as a result of large scale ICs, we had to go that route, at any cost.

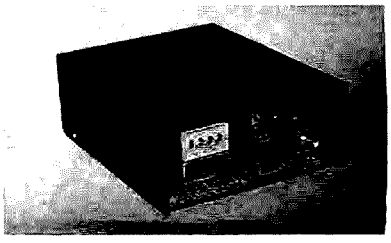
We started out with the Logiconcepts clock – a beauty. We use them in every part of the 73 offices. Those numbers lighting up are fun to watch, better than a navel. The only drawback was that the Logiclocks are over $100 and that limits their appeal a bit.

So along comes K-A Sales with a clock kit for $52.50! Grass did not grow under our feet – we sent for one. Beauty. With one enormous IC the clock converts the 60 hertz line into whatever it is the display numbers need to read out the hours and minutes – and, with a switch, the seconds. If that isn't enough it also has an alarm circuit built in, complete with a five minute snooze delay.

This clock is terrific for every ham shack. You can build it right into your control console and the alarm will help you remember those skeds – unless you are a lot better at remembering them than we are. We miss as many as we remember – or at least we did until K-A came along with this device.

If you get every accessory (most of them are just switches you probably already have) the whole bill only comes to about $75. Take a closer look at the K-A ad and see this gadget.

HIGH-RESOLUTION DIGITAL AUDIO SYNTHESIZER



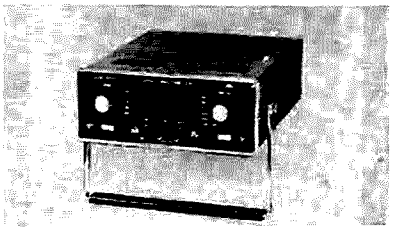
A new, precision frequency synthesizer with an output range of .1000 Hz to 9.999 MHz, and a single-unit price of $495, has been introduced by Syntronics Inc.

The unique solid-state instrument puts out a TTL-compatible square-wave signal having a frequency accuracy and stability of ± ppm from 0 to 50° C (With 1 ppm from 0–50° C available as an option). Frequency, to four signficant figures, is selected manually by means of front panel thumb wheels and a rotary switch which selects one of 8 available ranges. Decimal point poisition is automatically indicated by LED's on the front panel.

The Model SI-70 is believed to be the first high-accuracy instrument of its kind to carry a price comparable to that of many inherently less accurate audio oscillators and signal generators.

The new unit is extremely compact, measuring 8¾" x 3 1/8" x 6¾" and weighs approximately 5¼ lbs. Power requirements are 115V, 50–60 Hz @ 17 watts. Other options include: An output range extended down to .001 Hz; external BDC programming; external dc power unit; and an external 1 MHz-standard input. Write to *Syntronics, Inc., 169 Millham St., Marlboro MA 01752* for additional information.

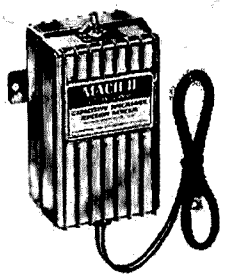
NEW LEADER DIGITAL MULTIPLIER



The LDM-850, a digital readout ac/dc multimeter that measures voltage, current and resistance in 25 ranges, is now being offered by *Leader Instruments Corp., Long Island City NY 11101.* It offers a dual slope operating mode and has a maximum input voltage of 1,000V dc and 350V ac with 10MΩ input impedance. Sensitivity ranges from 100 μV to 1V with current from 0.2 mA to 1,000 mA, ac or dc.

The Model LDM-850 measures 10" x 7¾" x 3¼" and weighs 10 lbs; priced at $299.50.

CAPACITIVE DISCHARGE IGNITION SYSTEM



C-D SYSTEMS has announced a totally new CD ignition system, the MACH II COMPU-SPARK. The unit is designed to permit the length of the spark to be regulated with engine rpm. A very long spark at low rpm aids starting and idle smoothness. A built-in three-position switch permits C-D operation, standard ignition usage or "off" as an anti-theft feature.

The ignition system utilizes only silicon semi-conductor components for reliable operation under extreme temperature conditions. The unit will operate with any 12-volt negative ground system. It carries a no time limit free repair or replacement guarantee and costs $49.95. A free brochure is available from *C-D SYSTEMS, P.O. Box 484, Berkeley CA 94701.*

destroyed the micas in the higher power version. Figure 5 is the photo of the model being described. As usual, the largest single component is the heatsink. The one shown is minimum in size for the rating. Since the heatsink could be secured to the case of the equipment, additional cooling would be available. Figure 6 is the four-in-series string which delivers 200W CW output. Figure 7 is the photo and, of course, is the experimental

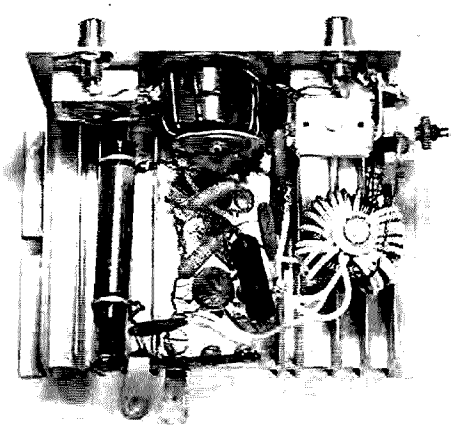


Fig. 5. 75W amplifier. Note heatsink size.

version. In both models the input circuits use a toroid made of ferrite cores by Amidon. For best efficiency, the driver stage would have the link secondaries wound over the primary; eliminating capacitor and toroid. A 50Ω output from the driver made development much simpler. Power measurements were made using a Bird wattmeter and dummy load. The driver was adjusted to deliver a maximum of 5W at 7.1 MHz. Driver turns ratio to primary was 5:1, but was not critical. Multicolored solid conductors proved to save time when wiring to the bases. All windings were the same in number of turns and polarities of phasing.

When the first model was made, all driving circuits to the base were series fed. About the only thing good about that connection was the self-oscillation. Simply by making the base shunt fed, the oscillation was stopped.

Here are some suggestions that may be of help in designing an amplifier that will operate as it should. I have seen as much as a 50% loss in power when the contacts were not as they should be.

1. All connections should be made with a mechanical contact, if possible with a copper strap. Then the joint should be soldered to prevent later corrosion.

2. Low resistance is a must in all circuits carrying rf, dc, or both. Don't take any chances with components when connecting to the heatsink or some other contact.

3. The conductor size should be large for best results. If a solenoid coil is used for the final, the wire size should be No. 9 or 10. If the toroid type is used, 3 sizes smaller will have the same rating when both windings are connected in multiple.

4. The number of turns is important in the tank coil if maximum output is desired. There is also the need of matching the load with the output. If a pair of ferrite toroids are used and wound as one core, the output will be reduced slightly but there will be space savings which may be important.

5. Each transistor should be balanced with the adjustment of the forward biasing resistor. When all are balanced for the same static current, the correct voltage division takes place and the dissipation should be reasonably uniform, as well as providing better linearity.

6. Do not be stingy with heatsinks! Operate the transistors cool if you want long transistor life. Blowers or fans can reduce the need for large heatsinks but there is the noise and other problems from the vibration and size of the cooler.

7. The use of silicon thermal lubricant is recommended, plus the secure mounting of the heatsink of the transistor to the heatsink.

8. The tuneup should be done with a variable rf source. Do not tune up at first with more than a few watts. The dc supply

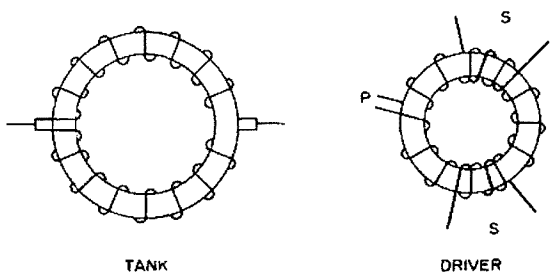


Fig. 5A. Toroid winding details for tank and driver coils.

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SOLID STATE POWER

For many years there has been a need for increased rf power from transistor amplifiers to replace the output tubes in exciters. Cost, efficiency, distortion, power output, reliability, and stability from temperature changes have prevented the use of transistors in hybrid equipment.

The obvious advantages of this design will not be discussed in this article, as the purpose is to disclose a method of generating higher rf power from small transistors. Although the cost of transistors is greater than tubes, it is now possible to eliminate tubes and still be compatible with present costs. Two experimental designs are presented here. The first has two transistors in series and delivers 75W CW on 7.1 MHz. The second version is made with four in series and has a maximum output of 200W with approximately 5W drive. Using series strings of transistors has the advantages both in load impedance current ratings, and only a slight increase in collector voltage. TRW manufactures an HF isolated heatsink Model PT4526 which was used for all tests. A few other types were tried and operated as calculated. The other types did not have the isolated heatsink which presented a problem in thermal dissipation and mica isolation.

General Background

Three basic circuits will be discussed briefly. Figure 1 is the well-known grounded emitter. Since transistors operate efficiently in this mode, there is a tendency under certain conditions to go into self-oscillation. A second and more serious problem is in regard to the loading. Should excitation be

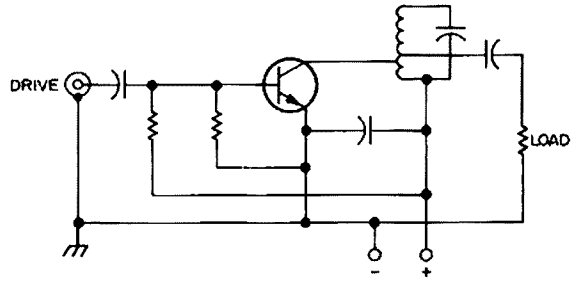


Fig. 1. Grounded emitter xstr amplifier.

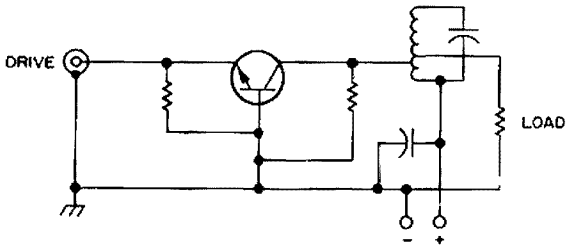


Fig. 2. Grounded base xstr amplifier.

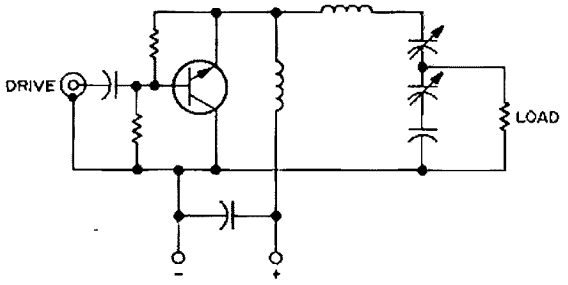


Fig. 3. Grounded collector. Notice detuning effect of the removal of the load.

applied without a load, the transistor in most cases will be destroyed due to the voltages developed in the high "Q" circuit.

Figure 2 can be compared to the grounded grid tube operation. This circuit is quite stable but requires more drive than the first circuit. For this reason, it was not used in the new design. Figure 3 is the grounded collector and has the following advantages: First, in the use of non-isolated heatsinks from the case, the collector is in good thermal conduction with the heatsink. Second, when the load is removed, the circuit is out of resonance and there is little danger of damage to the device with excitation applied. Third, much less driving power is required than the grounded base. Fourth, the circuit is quite stable in operation.

Description

The schematic diagram shown in Fig. 4 uses two TRW transistors in series. Toroids have been employed to save space. A smaller heatsink was also used, as there was less dissipation due to the reduced output. Small mica adjustable mica capacitors were used to contain the complete stage within the small heatsink. More output would have been obtained with larger components. The "L" net as shown has a different method of coupling than for the four transistor version. A link also could have been used, but this gave good flexibility in a small space. I might add that this is about the limit for compression micas. Increasing the power successfully

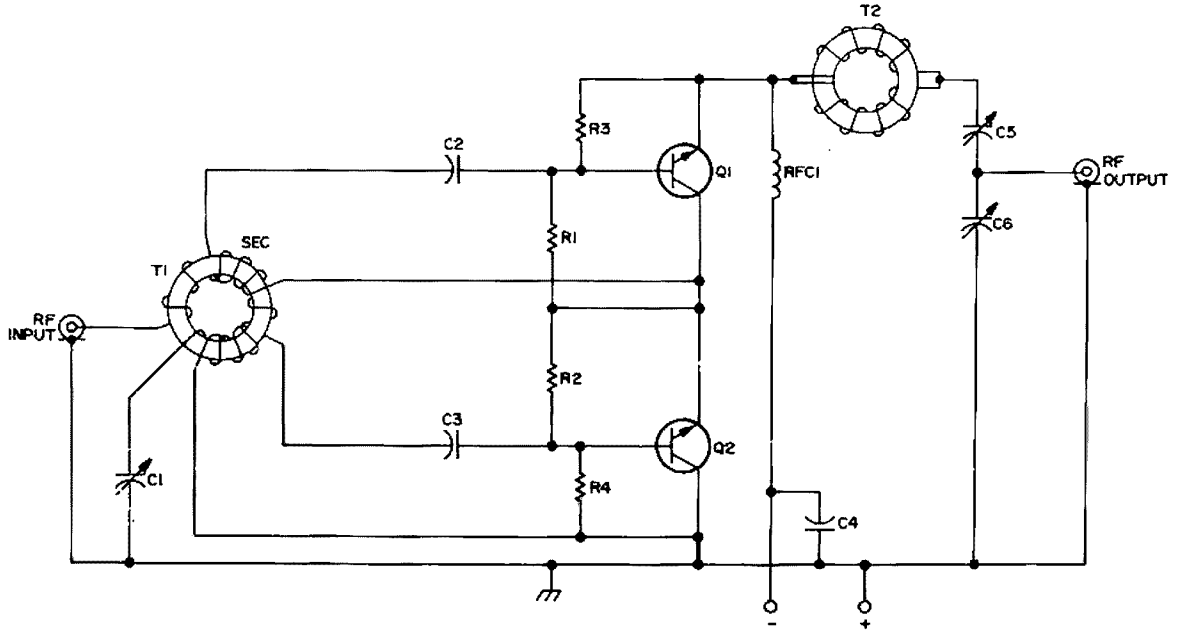


Fig. 4. 40m, 75W amplifier. T1: Amidon 15/16 in. toroid. Primary; 50T, No. 24. 2 secondaries; 10T, No. 24, solid insulated wire each. T2: Same type core except 2 used: 2 windings No. 16 Formvar 5T each connected in parallel. RFC-3/8 in. dia. ferrite rod, 60T No. 22 Formvar. C1, C5 – mica adjustable 200–800 pF. C2, C3 - 1 μF, 100V discap. C4 – .1 mF discap, 100V max., 25V min. C6 – mica adjustable 400–1200 pF. R2, R3 – 10Ω, 2–5W. R1, R4 – 450Ω. Q1, Q2 – TRW PT4526 or similar.

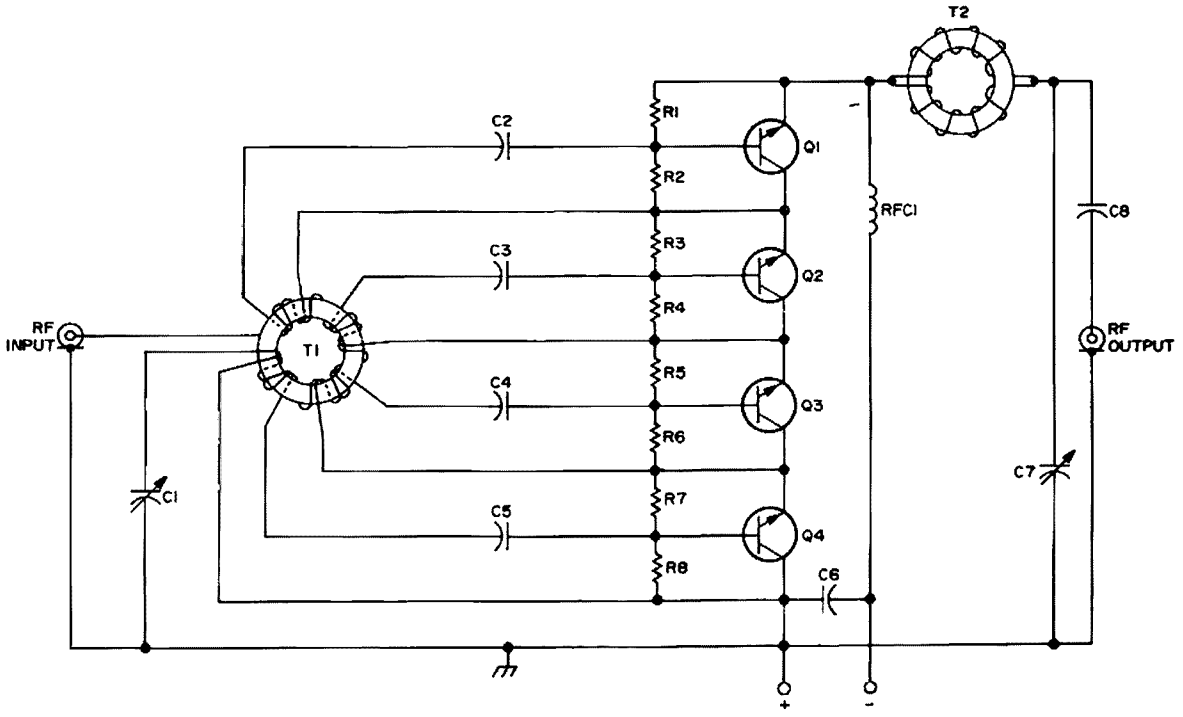


Fig. 6. 40m, 200W amplifier. T1: 2 Amidon 15/16 in. diam. toroids. Primary; 25T No. 22 Formvar. Four secondaries; 5T No. 22 Formvar each. T2: 2 airwound windings, 18T each, No. 14 Formvar, 1 3/16 in. diam. These windings are paralleled and shaped into a doughnut 3½ in. diam. C1 — 450 pF broadcast variable. C2 through 6 — .1 μF, 100V. C7 — 450 pF wide spaced variable. C8 — .01 μF, 500V (vary for best coupling). Q1, Q2, Q3, Q4 — TRW PT4526 or similar. R1, R3, R5 — 7 to 10Ω, 2 to 5W wirewound. R2, R4, R6, R8 — 450Ω, 1W. RFC — 3/8" diam. ferrite rod 50T No. 22 Formvar.

should be started at a few volts and raised to the maximum operating value only after the output is linear with the collector voltage. When an increase in dc voltage does not show much increase in output, reduce the collector voltage at once to a place where the linearity is restored. Operating above the linear point will only destroy the transistors. Increased loading usually permits the increase in collector voltage with a corresponding increase in power output. Always use a load to make the tests. After the amplifier is adjusted, both with the tank resonance and the drive resonance, then increase the drive. It should not be necessary to use above 5W of drive for high Beta transistors. Less efficient models will, of course, require more. Do not try to overdrive.

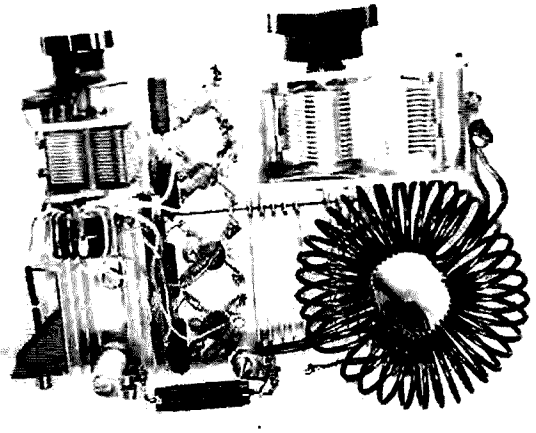


Fig. 7. Breadboard 200W amplifier.

Conclusion

The disclosure of this circuitry is done to aid those who wish to pursue the possibility of increasing the usefulness of solid-state amplifiers. No attempt was made to make a finished version, only to show one way to accomplish the production of higher rf output than has been previously possible. Although only tested briefly, the same excitation circuits worked on 75, as well as 14 MHz. The output was reduced in the final because of the improper LC ratios.

Wide ranges of operating frequencies should be possible when more time and energy can be expended in this direction. I have also considered the use of a push-pull "L" net for doubling the output. So far, not enough time has been available to pursue phase of development.

. . .W6EI/KH6HLN

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800 Fifth Avenue
Mendota IL 61342

AN RTTY SELCAL WITH TTL LOGIC

The Selcal or automatic character recognizer has become a fairly popular accessory in stations equipped for RTTY operation. Particularly so in the case of people interested in automatic use of their printer while they are not actually in the station. With this equipment installed, a receiver may be left on continuously monitoring a frequency for RTTY signals, and the printer will start up and print a message only after the call letters of the station (or other start-up coded sequence) are received through the station terminal unit. A suitable turn off sequence to stop the printer is included.

The original description of a circuit of this type appeared in 1968.[1] It made use of the TRL logic available at that time. Since then, the entire line of TTL logic has become readily available to amateurs, and in fact is now so low in price as to be more than competitive with the RTL used in the original Selcal design. The merits of TTL have been discussed at length; and the great number of special and medium scale integration circuits available makes it very attractive for projects such as the Selcal.

With the thought of updating the circuit somewhat, yet retaining the original logic idea, the circuit to be described was devised and tested. This article describes the logic diagram, timing chart and functioning of the circuit; and presents a basic TTL design for the character recognizer which can be expanded for other features as desired.[2,3]

The overall circuit diagram is shown in Fig. 1. A preliminary glance at this shows it to be somewhat less formidable than the diagram of the original unit. This is mainly due to the use of two SN 7496 5-bit shift register medium scale integrated circuits. These replace the shift register which had to be hand wired in the case of the RTL design, and take care too of the turn off sequence circuit. The decoding is identical to the original using JK flip-flops.

Input

The input circuit shown in Fig. 1 (Q1 and Q2) can accept information from a number of sources. Probably the best input is a regenerated RTTY signal from the terminal unit which switches from a positive voltage on space to a negative voltage on mark. This sort of signal is available with the floating loop type terminal units like the TTL/2 and ST-6 that are favored by serious enthusiasts. A system making use of the keyer transistor with an emitter resistor as used in the ST-3 and ST-4 demodulators followed by suitable transistor circuitry has been described.[4]

For use with older type terminal units, it is possible to connect the input of Fig. 1 to the audio voltage developed on the space filter coil of the demodulator. This connection is often brought out as one lead to be used on an oscilloscope display of the received signal. If this connection is used, it is important to make sure that there is sufficient isolation between the T U filter

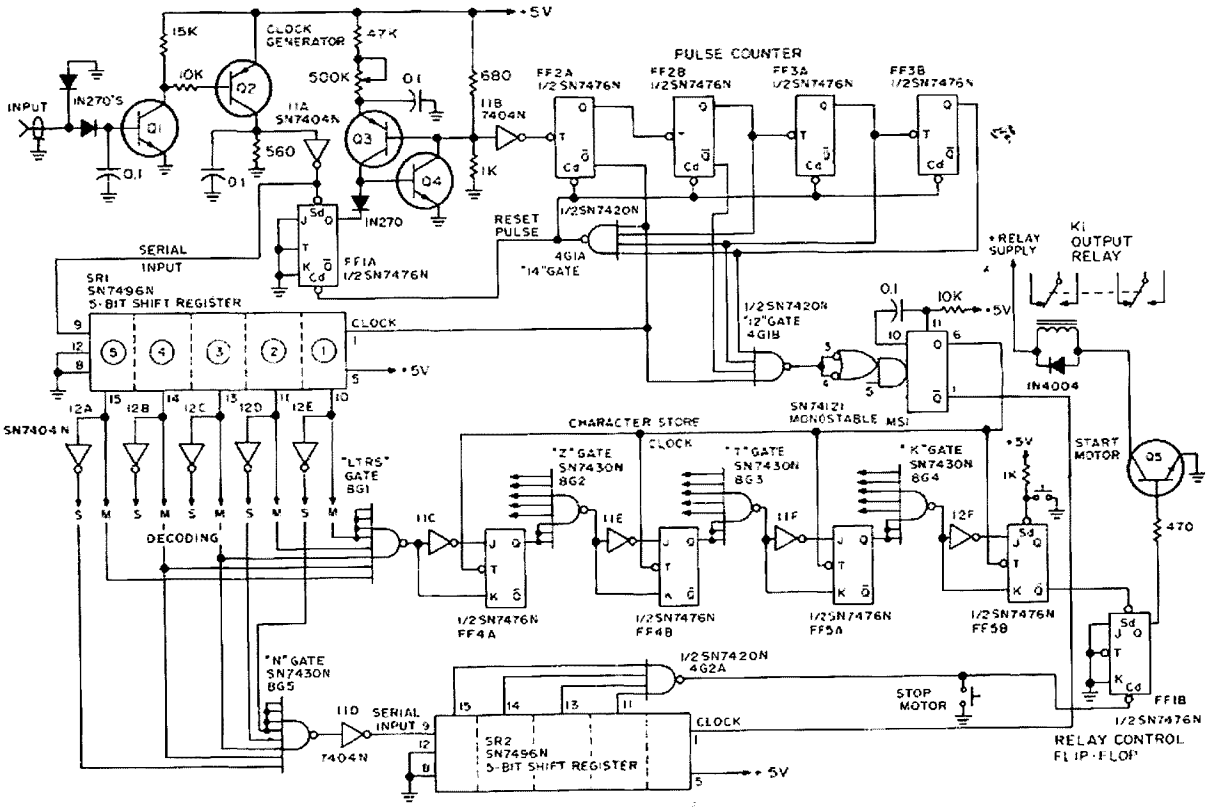


Fig. 1. TTL Selcal — logic diagram.

circuit and the Selcal input to prevent undue loading effects. Not much audio voltage is required to "trigger" the circuit. The diodes in the input circuit take care of rectifying the audio if used, or make correct usage of a digital type plus/minus signal if this is supplied.

For the condition of a continuous mark input, Q1 and Q2 are both off, and there is no voltage developed across the 560Ω resistor in the collector of Q2. This resistor acts to pull down the input of the SN7404 inverter, IIA, which is connected to the collector of Q2. Since its input is low, the output of this inverter is high for a mark condition. If the input to the Selcal goes positive (for a space signal) or audio voltage from the space filter appears at the input, Q1 and Q2 both get turned on; and the current through the Q2 collector resistor brings the inverter input up high, and so its output is then low for a space condition.

The base of Q1 and collector of Q2 are shown bypassed with 0.1 μF capacitors, and it is important that these values do not become too large so that the input switching circuit can accurately follow the reversals from mark to space of the RTTY signal and provides a good solid TTL level logic signal to the rest of the circuits.

Clock Generator Circuit

The clock circuit is familiar and has seen much use in electronic keyers and the like. It makes use of two transistors (Q3 and Q4)

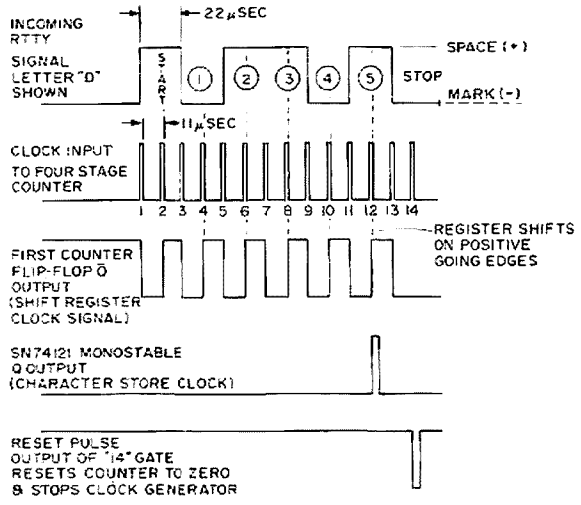


Fig. 2. TTL Selcal — waveform/timing diagram.

and one half of an XN7476 dual JK flip-flop which is used as a control element to start and stop the clock. When connected as in Fig. 1, Q3 and Q4 act much like a unijunction transistor, but with increased reliability in operation at lower supply voltages.

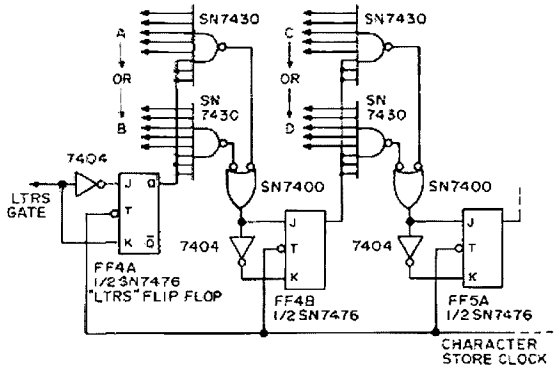


Fig. 3. Expanded decoding TTL Selcal.

As the 0.1 mfd capacitor at the emitter of Q3 charges up, a point is reached where Q3 starts to conduct and as this happens, Q4 also starts to turn on. Conduction in Q4 makes Q3 conduct even harder, so the result is a collapse of the capacitor charge in short order after which it starts to recharge, and the process repeats. The clock rate may be adjusted by varying the resistance in the charging circuit. A 500 K potentiometer is shown in Fig. 1.

The JK flip-flop during the mark condition is reset, and the Q output is then low. This clamps down the base of Q4 and stops the clock from running. As soon as a start pulse from an RTTY signal (space) comes along, this flip-flop gets set through its direct set input making the Q output go high. This allows the clock to start running. Note that as soon as the base of Q4 is not clamped to ground any longer, the clock immediately begins by generating a pulse since the capacitor at the emitter of Q3 is sitting there charged waiting for a space signal to come in. It is not necessary to go through a charge cycle on the capacitor which makes for more reliable synchronization of the clock and incoming RTTY signals.

The clock is stopped again when the control flip-flop receives a clear pulse. The operation of this portion of the circuit is covered during a discussion of the counter circuit and its associated decoding.

Pulse Counter

The pulse counter consists of four JK flip-flops which are series connected as a ripple counter. If not reset, they could provide a count of sixteen. The clock pulses from the collector of Q4 are thin negative going spikes, and are inverted to clean them up and provide a suitable thin positive pulse clock signal for the first flip-flop in the counter. The clock runs at twice the RTTY rate; 11 milliseconds for a 60 speed signal. By adjusting the clock frequency, other speeds can be accomodated.

So upon receiving a start pulse (space) from an incoming RTTY signal, the clock immediately begins running generating an input pulse to the counter forcing it to the count of one. The clock remains running and toggles the counter until the count of fourteen is reached, at which time it is reset to zero by the four input nand gate labeled "14" gate. This gate also feeds its output back to the clock control flip-flop and resets it stopping the clock after the count of 14.

There is another decoding gate connected to the counter circuit which detects the count of twelve on the counter. At this time, the output of the "12" gate goes low which triggers the SN74121 monostable I.C. This monostable is used to generate a one short pulse which is applied to the character recognition flip-flops to store a valid character if it is present in the register on the count of twelve.

The SN74121 is a versatile circuit. It can be triggered to generate a one shot output with either a positive going input on pin 5, or a negative going input on either pin 3 or 4. The negative going input is used here with pins 3 and 4 tied together. When the negative going input is used, the voltage on pin 5 must be at a high level (1 state) or else simply left unconnected as shown, which automatically places it at logic 1. The monostable also has suitable connections brought out for connection of external timing components to set the length of the pulse generated. The 10K resistor and 0.1 μF capacitor shown generate a pulse of suitable width for this application; slightly

less than a millisecond. Thinner pulses could be used to clock the character store flip-flops. With no external timing components, the monostable generates an extremely thin output pulse; something in the nanosecond area.

Shift Register and Character Recognition

The incoming RTTY signal reversals are fed into the character recognition shift register, SR1, and this register is clocked once every 22 milliseconds (for 60 speed) by the "not-Q" output of the first flip-flop in the pulse counter. The register shifts on a positive going edge as it has internal buffering on its flip-flops in order to present a single normalized load to the driving circuitry.

The SN7496 shift register has a serial input, and also inputs so that the individual flip-flops can be present to any desired state. The enable input for this preset function is pin 8 on the I.C. and is grounded in this application as the preset inputs (parallel load) are not used.

So, as an RTTY character start pulse comes in, the counter starts and clocks SR1 entering the various bits of the RTTY character in serial fashion. Inspection of the timing diagram, Fig. 2, shows that when the counter reaches the count of twelve, the start pulse has been shifted out the end of the register, and its five flip-flops contain the states corresponding to the RTTY character input. These states are a logic 1 for a mark bit, and a logic 0 for a space bit. At this point in the counting period, the character is in the register and ready to be inspected to see if it is one of the desired characters in the turn-on sequence.

Decoding

The Selcal as originally devised was used to look for and detect four consecutive RTTY characters, the first of which was the LTRS character sent after the area numeral in a typical amateur call sign. The logic diagram in Fig. 1 shows circuitry for a similar decoding sequence. However, if one's call letter suffix is not likely to occur in normal English text, the LTRS character may be omitted, using just the three letters of the station call. For two letter calls, the LTRS character probably should be included depending upon the make-up of the two letter suffix.

Omission of one or more letters for turn-on can eliminate a flip-flop in the character storage section if desired. Addition of the necessary circuits is worthwhile if maximum prevention of unwanted starts is desired, and the required circuits do not cost much.

Since only the true (Q-output) outputs are available on the I.C. shift register, a bank of inverters is used to provide a signal which will be at logic 1 level for a space entered in that flip-flop. The outputs before inversion are at logic 1 for a mark entry. This arrangement then provides a set of five lines, all of which will be at a high level if and only if the proper character is entered in the shift register.

The coincidental logic 1 on all five lines is detected using a series of 8-input nand gates (SN7430). The unused inputs on the gates are tied to one of the used inputs. When a desired character comes in, the output of the 8-input gate goes low since all its inputs are high for this character. Any other character input will provide at least one logic 0 input, making the output of the decoding gate high.

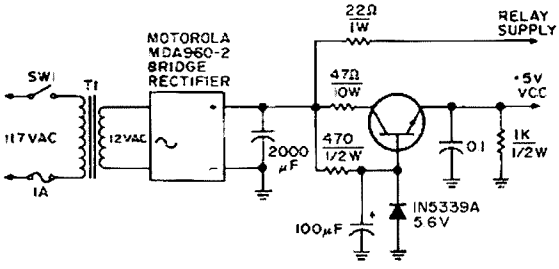


Fig. 4. TTL Selcal typical power supply.

Character Storage

The outputs of the 8-input character detection gates are applied to the inputs of four JK flip-flops, and these flip-flops are all clocked simultaneously by the pulse generated by the monostable, MS1, on count twelve in the counter. These flip-flops can only change to the true state (Q output at logic 1) if the J input is high. This state of affairs on the J and K inputs of the flip-flops

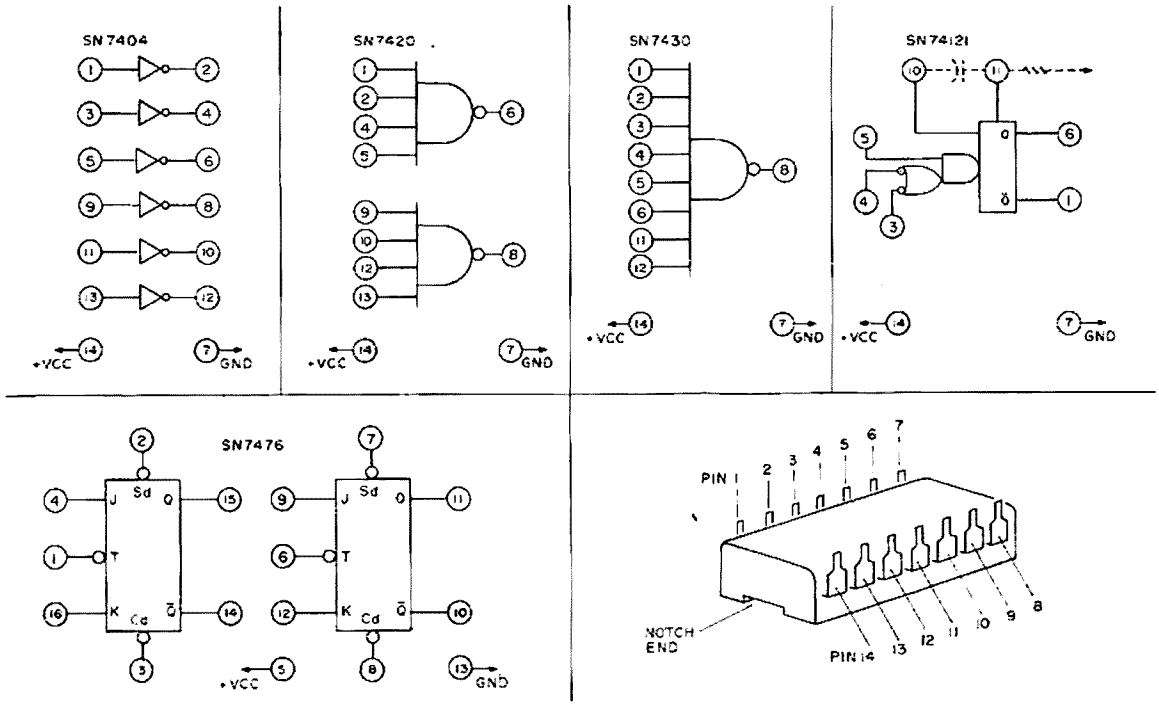


Fig. 5. TTL Selcal integrated circuit pin connections.

is present only when the desired character has been entered in SR1. In addition, the second, third and fourth flip-flops in the chain are fed with information containing the state of the previous flip-flop. If it is not at true level, the following flip-flop cannot change state. What this means is that for normal RTTY inputs containing text, the four flip-flops are continuously being reset by the clocks from MSI. However, for example, any time a LTRS character is received, the first flip-flop FF4A, will be set; and if the next letter is the appropriate one in the call letter sequence, the FF4A will be reset on the next character store clock, while the second flip-flop, FF4B, will then be set because the LTRS character has been received and FF4A was in the high state when the clock was applied. In this manner, only reception of the four desired letters consecutively can make the flip-flops FF4A, FF4B, FF5A and FF5B go set in "domino" fashion. Any false letter in the series stops this "cahin reaction."

When the last letter in the sequence has been properly recognized, the FF5B is set, its not-Q output applies a logic zero to the direct set input of FF1B and sets it which in turn drives on the relay through Q5. FF1B remains set even though other RTTY characters now come through the system, until it receives a turn-off pulse.

Four "N" Turn-off

Amateur users of the Selcal and other stunt box devices have adopted the standard commercial turn-off sequence of four "N" characters sent consecutively. In the TTL design for this Selcal, a different method of detecting four consecutive "Ns" is used, and makes use of another of the SN7496 5-bit shift registers. This further simplifies the circuit.

An 8-input nand gate, 8G5, is permanently wired up to detect the presence of an "N" character in the shift register, SR1. The "N" detection shift register, SR2, is clocked once each character by the inverse character store clock generated on count twelve. The not-Q output of the monostable provides this inverted clock signal.

If an "N" is present in the first shift register, the output of 8G5 will be low, and a logic 1 applied to the serial input of SR2 through the inverter ahead of it. When the clock comes along, the logic 1 is shifted into the register; and if a second "N" comes along, it too shifts a logic 1 into the register shifting the first 1 further along into the register. If four "N" characters come along,

the register will contain four logic 1 levels, and this situation activates the "N" decoding gate, 4G2A. Its output immediately goes low and this resets the relay control flip-flop at the direct reset input and opens the relay.

Hit Gate

Readers familiar with the original Selcal design will note that the TTL Selcal contains no hit gate. This feature was included in the original circuit to sense if a mark condition occurred part way into a start pulse. This situation would arise when the input was triggered by receiver noise and the like. If a "hit" was indicated, the pulse counter was reset and started over, so that continuous monitoring of receiver noise would not eventually provide the proper data inputs and give a false turn-on.

Since most of the more recent terminal units like the ST-3, ST-4 and ST-6 contain an autoprint section which requires a valid RTTY signal to be present for a short period of time before any loop output signals can be generated, the hit gate did not seem to be necessary, assuming that inputs for the Selcal were derived from the loop circuit in some fashion

However, if input information were to be taken from the space filter audio voltage as mentioned earlier, some unwanted turn-ons from receiver noise might be expected.

Power Supply

The power supply must handle a 5V dc for the logic circuits at a couple hundred milliamperes, plus a suitable dc voltage to operate the control relay. A typical supply for use with the 12V dc relay listed is shown in Fig. 4. The relay is a DPDT type and requires a coil current of about 80 mA for operation. Its contacts are rated at 10 amps ac and will handle the typical motor on a teleprinter. The unused set of contacts can be used for other control functions as desired. For example, they might light a light or activate a chime in a living area of the home to indicate that the printer was on.

Other Turn-on Sequences

Some Selcals were originally set up so that they would also turn on the printer upon receiving the combination LTRS*N*LTRS*N. This signal was used as an "All Call" sequence so that all the machines monitoring a given frequency using the Selcal could be turned on simultaneously by a transmitting station. Recognition of "QST" as an all call or the call letters of another active station on an autostart frequency are also popular.

One possible solution to the addition of a second set of turn-on letters is to decode only the mark and space bits which are common to each character. For some combinations of letters, this does not produce enough ambiguity among other possible letter combinations to give many false starts, and this system can be implemented without additional logic. In the simplest case, tying all the inputs of the 8-input decoding gates to logic one will give a turn-on after receiving any four valid RTTY characters and provides some protection from CW and continuous carriers over that normally provided by the autoprint and motor control circuits in the demodulator.

In most cases, it will be more suitable to slightly expand the decoding logic as shown in Fig. 3. This allows for two different turn-on combinations to be decoded if desired. However, it should be recognized that not only does this allow for these two sequences, but others as well as each stage of decoding is an "or" arrangement introducting a number of other possible combinations which will turn on the printer. The use of the LTRS character in the first place is of great benefit when this expanded code is used, but the combinations in each instance should be examined to see how many ordinary three letter words might be possible as valid turn-on codes. In most cases the first LTRS character pretty well eliminates false starts.

The addition of this logic requires an SN7400 quad two input nand gate as well as three more SN7430 eight input nand gates for decoding the three additional characters. Of course even further expansion would be possible using gates with more inputs.

Parts List

A list of parts for the major components is given. Also shown is a chart of I.C. pin connections for all but the SN7496 shift

register, whose pin connections are indicated on the main logic diagram, Fig. 1.

The integrated circuits can all be obtained from a number of sources that advertise in the amateur magazines. They should cost somewhat under $20 when obtained on the surplus market.

Substitution for the transistors shown is easily possible as any switching types will do in these circuits. 0.1 μF Sprague Orange Drop type capacitors are specified throughout to be consistent, but the only requirement for a stable capacitor of this type is in the clock circuit. Others can be disc ceramic or other bypass types if they are available.

If another dc supply voltage is available, it might be used to operate the relay for motor control. The newer solid state de-

TTL SELCAL PARTS LIST

Integrated Circuits
I1, I2 – SN7404 hex inverter

4G1, 4G2 – SN7420 dual four input nand gate

8G1, 8G2, 8G3, 8G4, 8G5 – eight input nand gate, SN7430

SR1, SR2 – five bit shift register, SN7496

FF1, FF2, FF3, FF4, FF5 – SN7476 dual JK flip-flop

MS1, SN74121 monostable multivibrator

Transistors
Q1, Q4 – 2N4124, NPN silicon
Q2, Q3 – 2N4126, PNP silicon
Q5 – relay driver transistor, 2N697 or equivalent

Capacitors
0.1 μF Sprague type 225P Orange Drop, 100V dc (4)

Resistors, ¼W composition
560Ω (1)
680Ω (1)
10 KΩ (2)
1 KΩ (2)
15 KΩ (1)
470 Ω (1)

Diodes
1N270 germanium (3)
1N4004 silicon (1)

Relay
Allied Radio Type KN105-2C-12D, DPDT, 12V dc coil, 80 mA

modulators mentioned already contain a motor control relay, and it might well be put to use in some way or other to be used in conjunction with the Selcal output signal. The method of control seems to be an individual thing which is best suited to the station at hand. Each one seems to be slightly different as are most RTTY installations overall.

Conclusion

In building this sort of circuit, be sure to include adequate bypassing on the 5 volt Vcc line around the circuit board. In addition a shielded enclosure for the circuits is a must to eliminate stray rf from getting in and upsetting circuit operation. Adequate filtering and bypassing of the signal lines going in and out helps here too. However, in most cases, a nearby transmitter will not be operating when the Selcal is required to do its job, unless of course, the station is transmitting on one band while monitoring another band at the same time. In such a case, rf elimination can best be achieved on a cut and add basis for the individual station layout.

A couple of Selcals using this circuit have been built by other amateurs using hand wiring techniques. These operated without difficulty. The author will be glad to try to answer individual queries regarding the circuit, construction techniques, etc. The considerable simplicity of this design makes for much easier wiring, even on a point to point basis, eliminating much of the chance for error in the final product.

...W9ZTK

SOURCE FOOTNOTES

1. Malloch and Lamb, The Selcal – An RTTY Character Recognizer, 73 Magazine, May 1968, Page 58.

2. Wenskus, The Selcal As A Signal Analyzer, *RTTY Journal*, July – August 1971.

3. Chan, An Auto-Responder for the Selcal, *RTTY Journal* June 1971.

4. Haynes, A Standard System for Simple Station Control, *RTTY Journal*, January 1971.

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AN INTEGRATED CIRCUIT TRF RECEIVER

An inexpensive Integrated Circuit has been available for some time which contains the complete gain, detection and agc functions required in 455 kHz AM i-f strips. Intended for use with ceramic filters and an outboard front-end converter, the LM372 is presently designed into the AM section of several commercial AM/FM high fidelity receivers, where it replaces the hand-assembled "i-f can" type strip formerly used.

The LM372 is, in reality, a much broader-band device than its 455 kHz applications would suggest. It has useful sensitivity throughout the AM broadcast band, the 160 and 80 meters bands, and even into the 40 meter band, when used to amplify pretuned AM signals directly from an antenna. Sensitivity, of course, is not as great as when used with the additional gain of a superheterodyne conversion stage, but is adequate for urban area broadcast reception, or local 160 and 80 meter net reception.

As may be seen in Fig. 1, there is considerable difference between the LM372 and a conventional i-f strip. The IC is basically a very high gain dc amplifier, with all its gain in one "lump," as opposed to the transformer coupled individual gain stages usually used. To keep the dc biasing constant, a negative feedback loop is used, with capacitor C3 making the loop effective for dc only; thus, ac (rf) gain is not reduced by the feedback system.

In conventional strips, agc is performed by shifting the dc biasing of the individual gain stages, effectively reducing their gain for strong input signals. Unfortunately, such bias shifting detunes the conventional interstage transformers. In the IC, however, the gain stages operate at maximum efficiency at all times; they are preceded by a separate agc attenuator stage, which can cut incoming signals by as much as 80 dB (10,000 to one).

Conventional diode-type AM detectors require dc biasing through the last i-f "can" in the strip, and are inherently nonlinear, causing distortion. The LM372 uses a more sophisticated detector, adapted from the op-amp type peak-following circuits used in analog computers. In this "active detector," the diode is inside an amplifier's feedback loop, which automatically biases the diode for linearity with small signals, actually gives voltage gain, rather than the loss of conventional detectors, and is directly, rather than transformer coupled, to the output of the gain stages. In Fig. 1, C5 is the detector smoothing capacitor, with the R4, C4 combination forming the agc loop.

The schematic of Fig. 2 illustrates in detail how the blocks of Fig. 1 operate. With no agc, Q2 is simply an emitter follower, with unity gain. Its output is coupled to the three gain stages, Q6, Q7 and Q8, whose output is directly coupled to the active detector, formed by Q11, Q12 and Q14. Dc feedback for the gain stages is performed through R8, C3, Q5, R6 and R7.

As input signals become stronger, the dc output level of the detector, at pin 6, rises

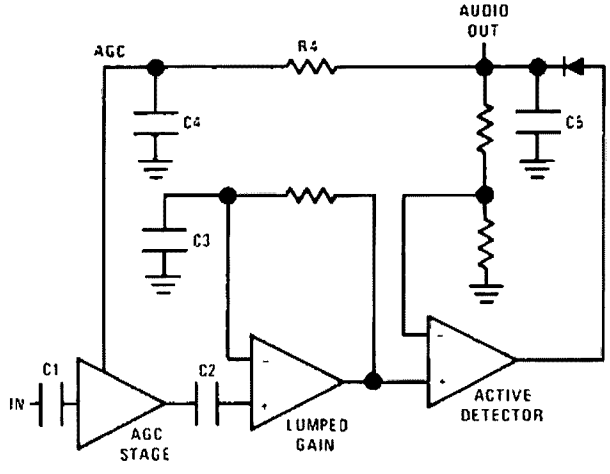


Fig. 1. LM372 block diagram.

R4 and C4 couple this voltage, with the audio component filtered out, to Q4 and Q3. Stronger signals begin to turn on Q3; since Q3 and Q2 form a differential pair, this tends to turn off Q2, giving an agc action that is both series (turning off Q2) and shunt (turning on the low-impedance emitter of Q3).

The string of diodes, D1–D7, and the various emitter followers attached to the string, act as separate power supply regulators for each stage of the LM372, which also eliminates the need for separate rf decoupling of each stage's supply line.

Broadcast AM TRF Receiver

As can be seen, there is no internal tuning in the LM372; it will amplify, detect, and agc all signals applied to its input. While in a superheterodyne receiver, it would be fed by an already bandpassed 455 kHz signal, the circuit of Fig. 3 allows it to roughly select any signal in the 550–1650 kHz band. The Tune Radio Frequency circuit has of course, poor selectivity, since it uses only a single tuned circuit which also acts as an antenna. Its selectivity is sufficient, however, to peak the desired station, which will then operate the agc so that overall gain is minimum required for that station. Thus, other stations will be far down on the single LC circuit's selectivity curve. More sophisticated designs might use multisection tuning ahead of the strip.

The prototype was constructed using very inexpensive imported "transistor radio" components. In fact, virtually any junked transistor radio will supply nearly all of the required external components for broadcast band use. A ferrite "loopstick" antenna, L1, resonates with a small, polyethylene dielectric tuning capactior. If operation is desired above the broadcast band, a smaller capacitor may be used, or the broadcast type may be connected in series with another capacitor, and then shunted across the coil, to lower the net capacitance.

The LM372 performs its gain function just as it would in an i-f application, but in this case directly drives a class A power amplifier. Since the dc voltage at pin 6 is relatively constant (varying from 2.1 to 2.4V

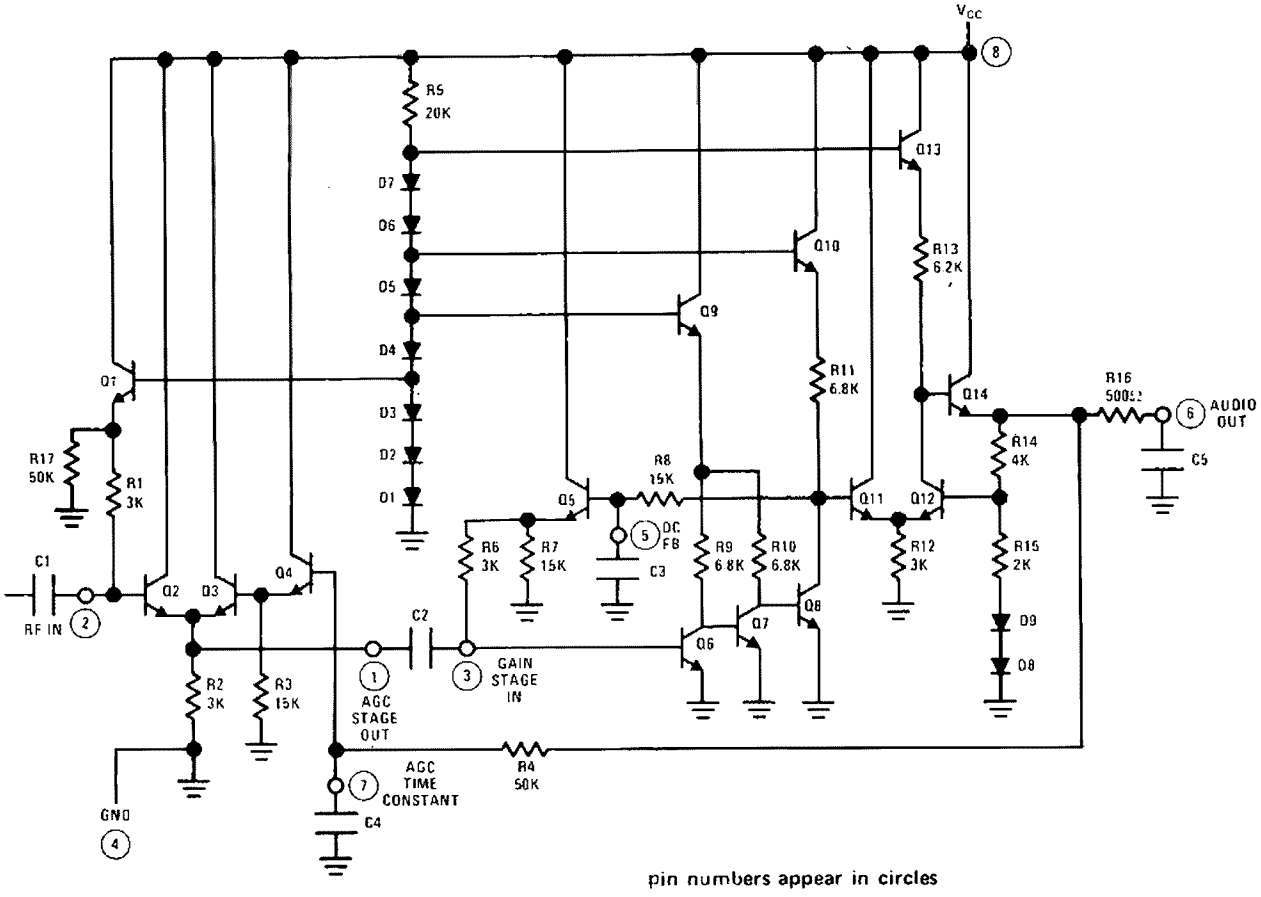
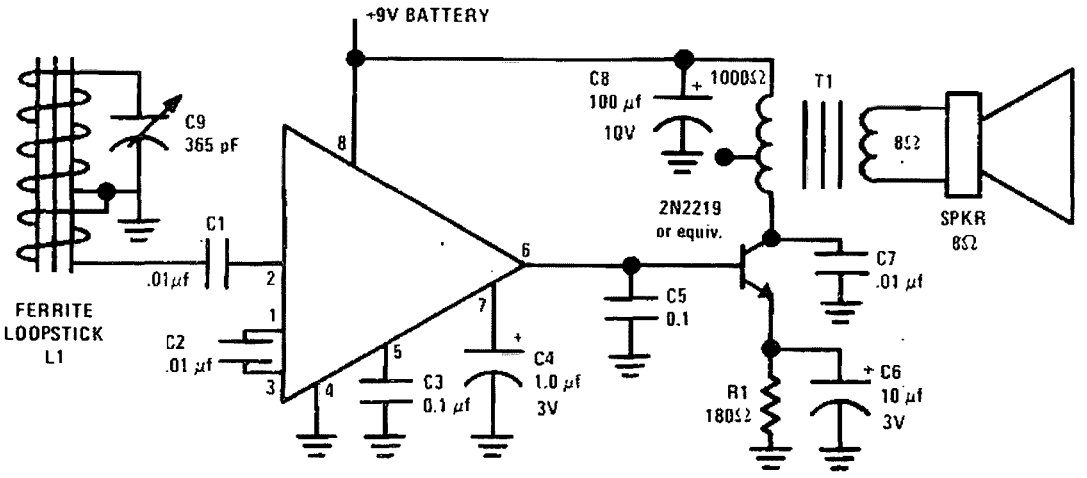


Fig. 2. LM372 schematic.



L1 – Ferrite Loopstick – Philmore FF15 (packaged as set of 3 sizes)
C9 – Sub-miniature variable capacitor – Philmore 1949G – 365 pF max.
T1 – Midget Audio Transformer, 1000Ω:8Ω – Archer 273-1380 (Radio Shack, Inc.)
SPKR – 2" PM Speaker, 8Ω, 0.1 watt – Philmore TS20

Fig. 3. TRF receiver using LM372.

as a function of agc), it is used to bias the class A stage directly, eliminating a number of extra components. C7 and C8 are needed to prevent regenerative audio oscillations with weak batteries. Care must be exercised in building the breadboarded circuit, as excessive lead length anywhere is likely to permit the very high gain strip to oscillate. A good technique is to use pin 4 on the TO5 can as a tie point for ground, and to connect all capacitors and other grounded leads to that pin with absolutely minimum lead lengths. Disc ceramics seem to have less stray inductance at these frequencies than the larger tubular types.

A volume control was not provided in the prototype, as volume was excellent with the small (2 in. diameter) speaker used, and agc was so effective that no perceptible difference in stations was heard in the broadcast band. A volume control which also reduces the class A stage's power drain at low levels can be achieved by inserting a pot between the emitter of the audio output transistor and R1. With the circuit shown, total drain from a 9V transistor type battery is 10 mA. of which only 1.9 mA is used in the LM372; the rest is needed for the audio amplifier.

Other Uses

Variations on the circuit of Fig. 3 might include padding of the C9 tuning capacitor, so that the loopstick could be used at 455 or 262.5 kHz as an i-f "signal sniffer" in receiver troubleshooting. If T1, C7, C6, R1, the speaker and audio output transistor are eliminated, the TRF receiver can be used, capacitively coupled, to drive high impedance headphones, or as a complete AM tuner in high fidelity applications. While selectivity is very broad, the high fidelity application will reveal that commercial AM stations really transmit more "tweeter material" than the average selective AM tuner will pass.

Another application would be to replace the loopstick with an equivalent shielded inductor, and to capacitively couple a broadcast-output VHF converter to the parallel tuned combination. Such a combination might be a simple answer to the monitoring of local VHF repeaters, where selectivity is unimportant.

Conclusion

The LM372 is a handy building block, in fixed i-f and TRF or variable i-f applications. A number of similar i-f "strips" are known to be under development; these will make the experimentally-inclined ham's life a lot more pleasant, and, along with other forthcoming communication-type IC's, should renew interest in the vanishing art of homebrewing.

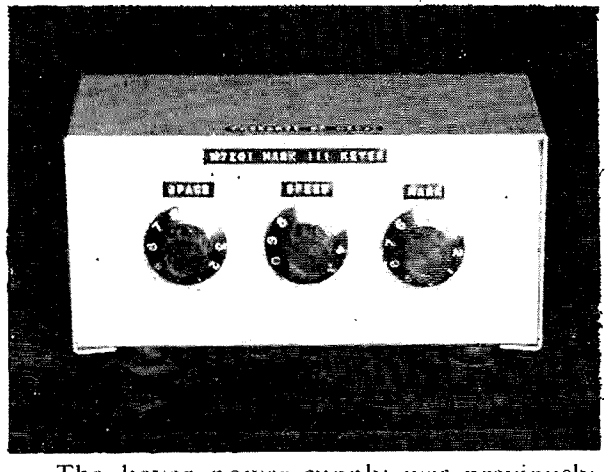
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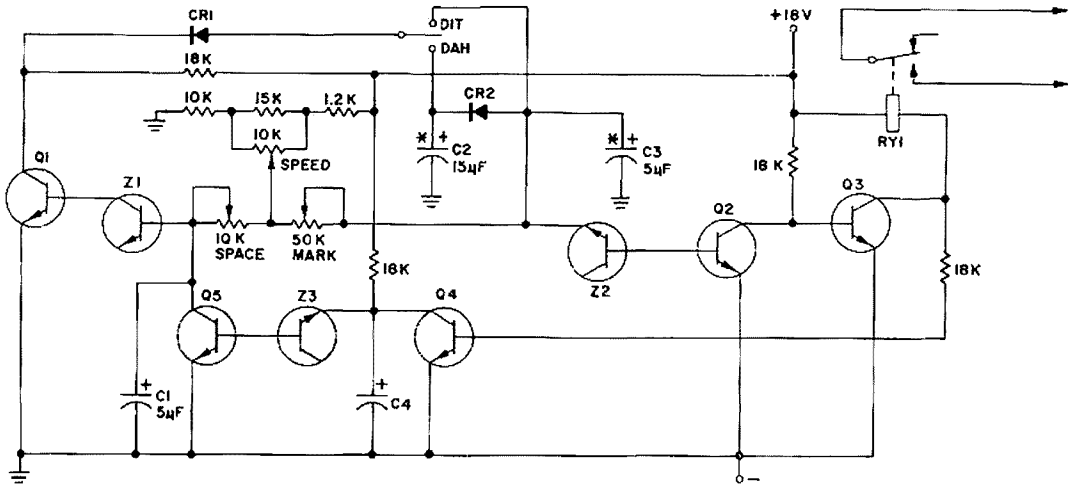
THE MARK III ELECTRONIC KEYER

The Mark III electronic keyer (Fig. 1) is the end result of a joint cooperative effort by its designer Wes Hayward W7ZOI, and myself. Design improvements were worked out by W7ZOI in response to my requests for improvements in the original keyer circuit[1], for fixed station operation.

The Mark III keyer uses two additional transistors (Q4 and Q5), which replace one set of DPST relay contacts formerly required in the original circuit. The addition of three Fairchild 2N3564 NPN-type transistors used as zener diodes (in the base circuits of Q1, Q2, and Q5) replace two penlite batteries formerly required for reference voltage in the emitter circuitry. The addition of Q4 and Q5 permits the use of an economically-priced SPST relay, in place of the more expensive DPDT relay. The addition of the "space" and "mark" controls was my idea, since the manual adjustment of the off (space) and on (mark) duration times is a very desirable feature to have on *any* electronic keyer.



The keyer power supply was previously covered in the original article, "A Simple Electronic Key," which suggested voltage doubling a 6.3V filament winding to obtain 18V dc. I added an 18V zener (International Rectifier Z1116) connected across the output of the power supply as shown in Fig. 2. The 18V zener stabilizes the output voltage at a constant 18V dc. Voltage stabilization is *most* desirable, since it helps stabilize the keyer timing circuits.



NOTES:
1. Q1, Q2, Q3, Q4, Q5 = 2N697 (NPN)
2. Z1, Z2, Z3 = 2N3564 (NPN) CAN ALSO USE 2N697, 2N388 OR GE-8
3. * = SEE TEXT

Fig. 1. Keyer circuit diagram.

Mark III Theory of Operation

For the benefit of those readers who do not possess the December 1965 issue of *QST*, the following explanation of Q1 through Q3 is briefly repeated. The theory of operation of Q4 and Q5 is added to cover the Mark III improvement.

During the "at rest" (paddle contacts open) condition, Q1 and Q2 are in saturation, Q3 is off, Q4 is saturated, and Q5 is off. See Fig. 1. Q1 is saturated because capacitor C1 in its base circuit is positively charged. Q1's collector current is maximum, and Q1 is said to be "saturated." Q2 is also saturated in a similar manner during this "at rest" condition. Q3 is off, because its base voltage is nearly zero volts (the same as the collector of Q2.) Q4 is saturated, because its base voltage is highly positive (the same as Q3's collector) and Q5 is off at this time, because its base voltage is nearly zero volts (the same as Q4's collector).

When the paddle "dit" contacts are closed, a negative pulse from Q1's collector is "steered" through diode CR1, and through the paddle "dit" contacts into the 5 μF "dit" storage capacitor C3. This negative pulse swings the base of Q2 negative, which turns Q2 off, and causes its collector voltage to rise to the supply voltage of 18V dc. The highly positive Q2 collector swings the base of Q3 highly positive, turning on Q3 (saturation). As Q3 goes into saturation, its collector current energizes the relay coil, which closes the relay contacts. Simultaneously, the base of Q4 drops to nearly zero volts (the same as Q3's collector), and Q4 is cut off. As Q4 turns off, its collector voltage rises to the highly positive supply value of +18V dc. Q4's high collector voltage swings the base of Q5 highly positive and Q5 goes into saturation. The emitter-collector current flow of Q5 causes a low resistance (short circuit) across the C1 "space" storage capacitor. This short circuit grounds the base of Q1, turning Q1 off. The collector voltage of Q1 rises immediately to the high positive value of the power supply voltage, but it does not upset the keyer sequence (even though the "dit" paddle contacts may still be closed at this time), because diode CR1 prevents passage of this positive high voltage.

The keyer circuitry continues in this "dit-mode" of operation, until the negative pulse (charge) on the "dit" storage capacitor (C3) has discharged through the "mark" and "speed" potentiometers to chassis ground. This, in effect, is the self-completion feature of the keyer. When C3 is discharged, the base of Q2 starts to rise toward a positive value. When Q2's base rises to approximately 0.7V, Q2 goes into saturation. This turns Q3 off, which opens the relay contacts and simultaneously swings Q4 into saturation. With Q4 saturated, Q5 turns off and removes the "short circuit" from the "space" capacitor C1. The *time* required for the voltage on C1 capacitor to rise to approximately 0.7V

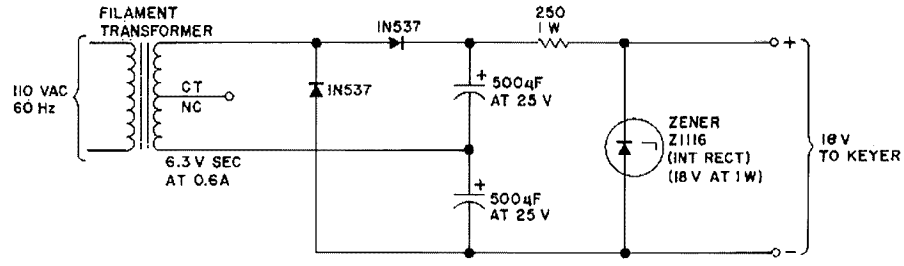


Fig. 2. 18 V power supply circuit.

creates the automatic space interval between dits. When this voltage reaches 0.7V dc, it swings Q1 into saturation. If the paddle is still being held in the "dit" position at this time, the entire dit sequence will be repeated. If the paddle had been returned to the neutral (at-rest) position prior to the saturation of Q4 and the turn-off of Q5, the keyer would only make one "dit".

When the paddle contacts are actuated to the "dah" position, the keyer operates in a similar manner as described for the dit sequence, except that the "dah" storage capacitor (C2) Diode CR2 (between C2 and C3 capacitors) steers the negative "dah" pulse into the "dit" capacitor C3, whenever a "dah" selection is made. The time required to discharge both storage capacitors should equal the normal "dah" duration time. For proper "dah" length, the combined capacity values of C2 and C3 should create a "dah" duration time which is 3 times longer than the "dit" time. However, because capacity values (as marked on capacitors) do not necessarily represent the actual capacity value, I recommend that these capacitors be selected by the "cut-and-try" method, until a satisfactory "dit" and "dah" length is obtained. (As a ball park figure, a continuous string of dits should cause the transmitter final plate current to hover at approximately 50% of the key-closed value. A continuous string of "dahs" should cause the plate current to hover at approximately 75% of the key-closed value.)

I added the 15K fixed resistor across the "speed" control to make the speed change more linear. The 1.2K fixed resistor at the top end of the "speed" control was added to limit the keyer top speed to approximately 45 wpm.

The "space" and "mark" potentiometer resistance values may require some juggling to cause the normal keying response to occur at the mid-range position of these controls. This juggling is necessary to compensate for the combined effects of relay return spring tension, relay contact spacing, relay armature mass, etc., which differs from relay to relay.

Construction Hints

The following construction hints are offered if the reader cares to duplicate my

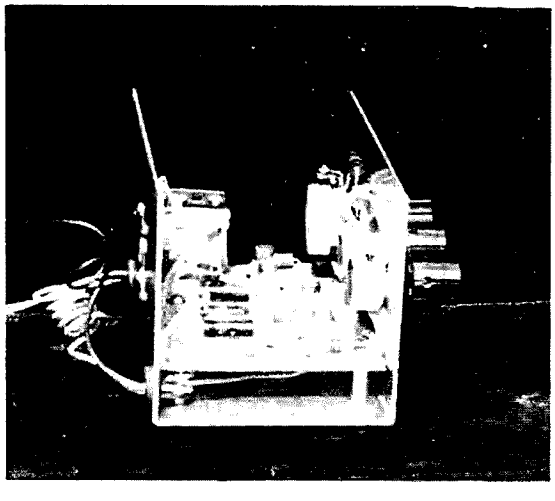


Fig. 3. Top view of keyer showing parts placement.

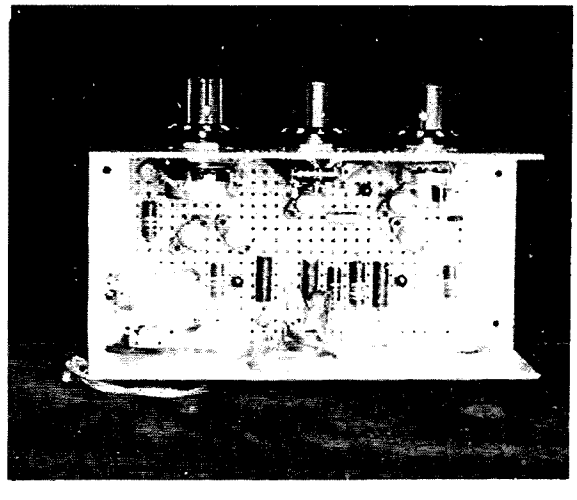


Fig. 4. Side view showing mounting spacers.

layout: Use a rectangular-shaped piece of phenolic pegboard as the base upon which to mount the circuit components (See Fig. 3). Use transistor sockets, so that transistors can be removed when troubleshooting or making continuity checks on the keyer circuitry.

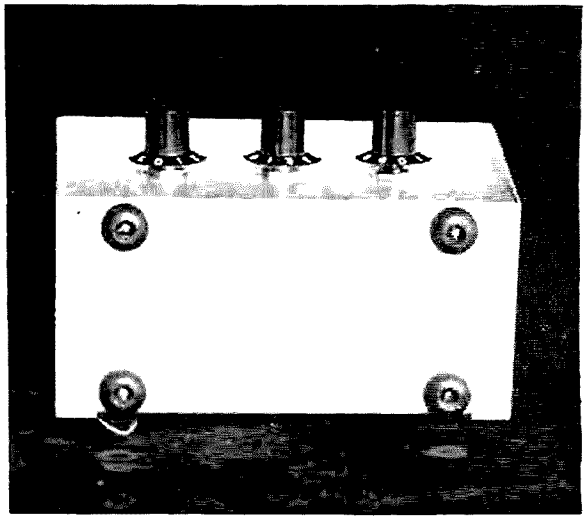


Fig. 5. Bottom details.

Support the phenolic pegboard at the corners with metal sleeve spacers (or equivalent) so that the pegboard is raised above the bottom surface of the metal cabinet. (See Fig. 4.) Use long machine screws to secure the phenolic pegboard to the metal cabinet. Pass these long screws upward through the rubber feet, the bottom of the cabinet, through the metal sleeve spacers, and through the corner holes in the phenolic pegboard. (See photos.) Secure long screws with lockwashers and nuts on topside of pegboard. Use a 1/8 in. thick, 2 in. square piece of plexiglas to insulate the 3-conductor jack sleeve connection from the hole in the backside of the keyer metal cabinet. Insert rubber grommets in the holes on the backside lower skirt of the metal cabinet to provide protection for transmitter key leads and power supply lead connections to keyer. When locating 3-conductor jack and "speed," "space," and "mark" potentiometers be sure to temporarily install the phenolic pegboard, so that the locations for the jack and potentiometers can be chosen in a manner which will not interfere with the components on the pegboard.

. . .W6JJI

[1] "A Simple Electronic Key," Wes Hayward WA6UVR, *QST* Dec. 1965.

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EMERGENCY POWER FOR THE HOME QTH

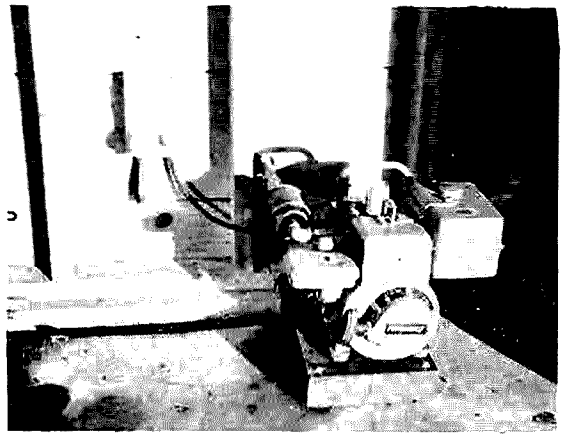
When the power goes off, do you reach for a candle or a power transfer switch? A small gasoline-powered alternator wired into the home electrical system can provide a lot of peace of mind by just being there. I live in a relatively remote area in the upper peninsula of Michigan. Power failures are not uncommon, and they can be a real inconvenience.

I installed an alternator large enough to operate the furnace, a few lights and the lower powered ham gear in the shack. The alternator was installed to be easily removable for field day or emergency service.

Installation

Nearly every installation will have at least slight variations. Also, wiring code requirements are not uniform nation wide. Some areas permit solderless connectors in service boxes, as would be used for connecting the alternator input line to the wiring harness. Other areas require all connections in service boxes to be made at rigidly mounted terminal blocks. Some may require the large commercial power transfer box regardless of the size of the alternator. If in doubt, contact the power company or public utility commission. It is beyond the scope of this article to go into the details of all types of installations or the automatic and semi-automatic power transfers.

There are two basic precautions to observe when installing an alternator. First, most power companies require a reasonably fail-safe switching system for power transfer so power from the alternator cannot be fed to the power lines. The interconnect also prevents the power from being accidently fed to the alternator with disasterous results. The ideal switch is the commercial power transfer switch. These switches are required for the larger 220 volt alternators. An acceptable, and considerably more



Alternator mounted in garage.

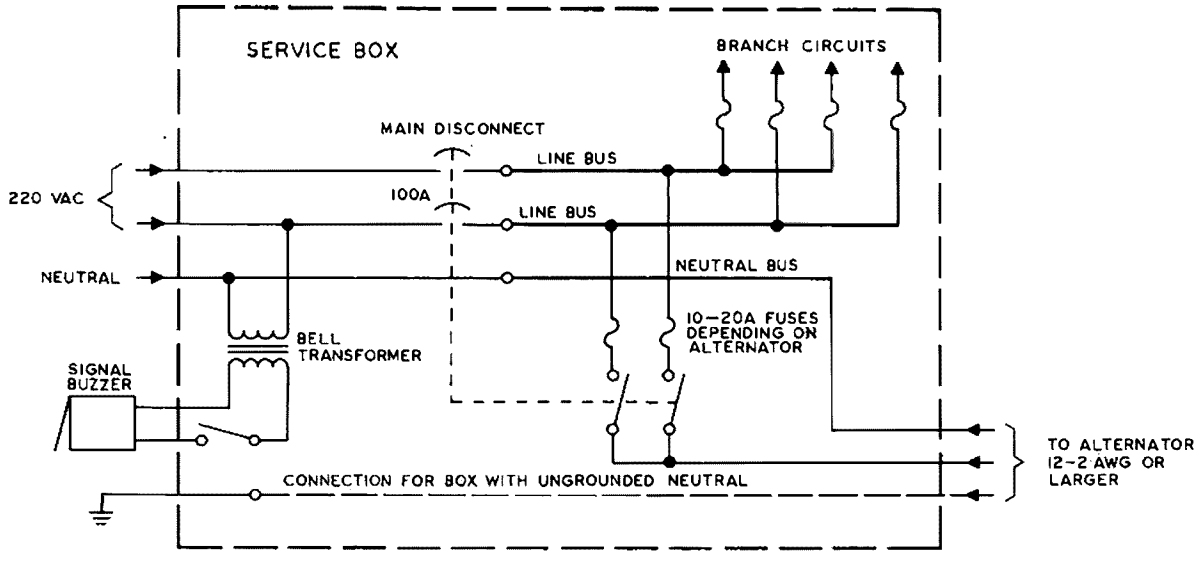
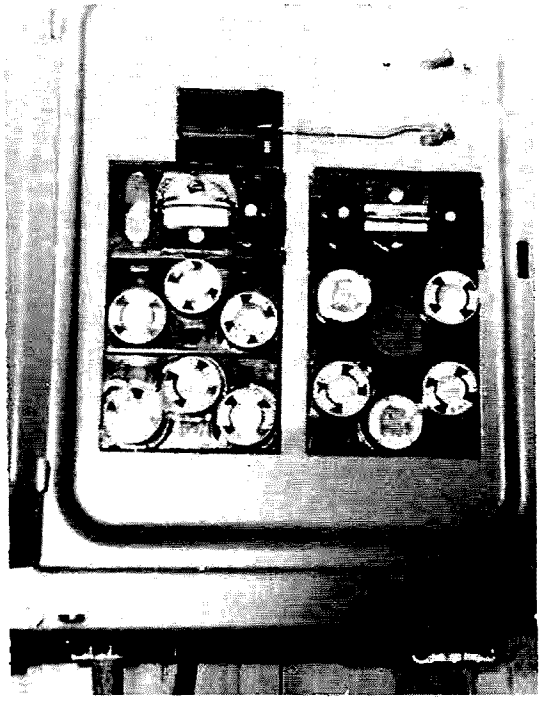


Fig. 1. Residence service box modified for power transfer switching.

economical, switch can be made for the small 115 volt alternators.

I have a hybrid service box with a circuit breaker for main disconnect and fused circuits. An all-breaker box would be wired essentially the same. The fused main disconnect will be described later.

The service box cover was removed and a 30 amp double pole single throw toggle switch was mounted to line up with the circuit breakers. The switch was a surplus unit with holes in the handle. A 1/16" steel rod was formed to make an interconnect between the switch and circuit breakers. The rod must be formed so it won't interfere with the circuit breaker action. With the rod in place, the alternator is automatically disconnected when the main disconnect is on and connected when the disconnect is off. To wire the transfer switch a wiring harness can be made from a piece of No. 12-3 or 14-3 stranded flexible cable. Length will depend on box. An additional two-circuit fuse block was plugged into the service box. If you use this system, be sure the fuses connect to each side of the line. If there are no extra fuse circuits, the alternator can be connected directly to the main bus lines, as it is fused at the control panel. Starting at the fuses, strip and connect the white and black wires. Cut off the green wire. Dress the cable to the alternator input and slit the cable to expose the green wire. Cut the green wire and connect it to the hot alternator input. Make the remaining cable long enough so the service box cover can be removed for service. Strip the white and black wires and connect to the outside terminals of the transfer switch. Strip the green wire and connect to both center terminals of the transfer switch.



Service box modified for power transfer. Note interconnect between main breaker and transfer switch. Signal switch is above transfer switch.

I have not made an installation for a fused main disconnect. Based on my wiring experience (licensed journeyman) the following notes will aid in making an acceptable installation. Bring the alternator input into the service box as with the circuit breaker box. The wiring harness can be a two conductor stranded flexible cable of No.

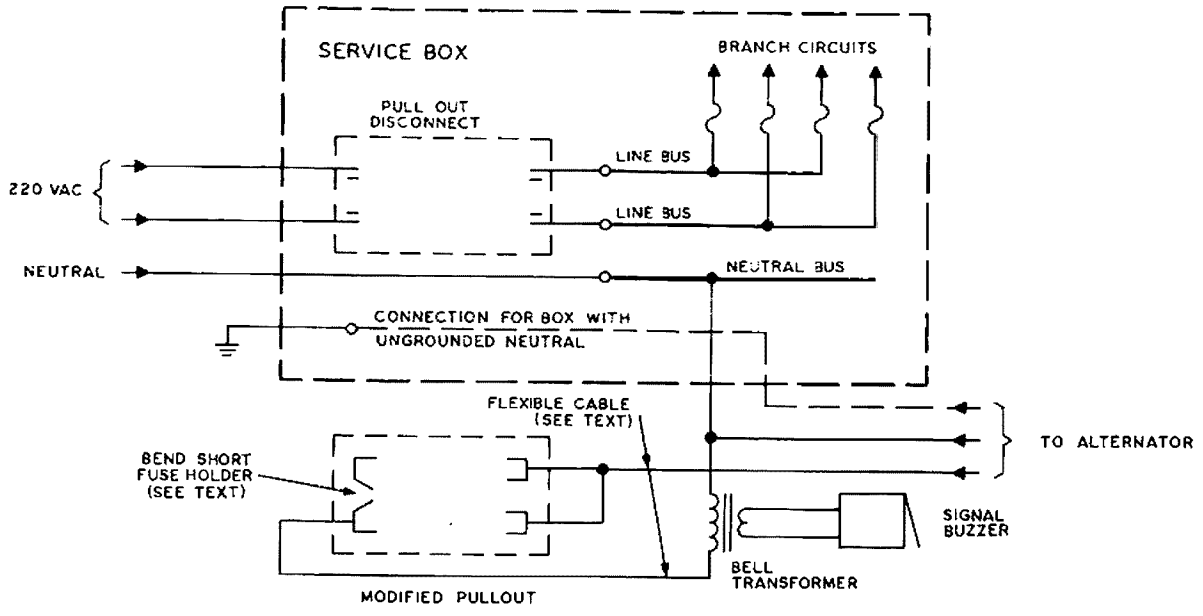


Fig. 2. Alternator connections for pull-out disconnect box.

12 or 14 wire for this box. Strip the white and black wires. Connect the black to the alternator input. Bring the cable out of the box and make it long enough to easily reach the main disconnect pullout. Get a replacement pullout and drill it so the black wire can be connected to both fuse terminals on the branch circuit end. Drill the pullout so the white wire can be connected to one fuse holder on the line side. The white wire will be used for the signal system described later. Bend the short fuse holder clip so a fuse cannot be inserted in this modified pullout. Make an insulated (wood is okay) holder for this pullout. The insulated holder will permit test running the alternator with no danger of short or shock to anyone around the service box when the alternator is running.

To transfer the power, the main disconnect is pulled out as usual. Plug in the modified disconnect for alternator power.

There are many other types of residence service boxes. The two described are the most popular in this area. If you have a pull lever for a disconnect, a small two-circuit lever box can be mounted above or below the service box and interconnected with a steel rod.

It is convenient to have a signal system to indicate when main line power has been restored. A bell transformer can be mounted inside the service box and connected to the main line input terminals.

The transformer is on, even with the main disconnect off, so it must be mounted inside the service box. A switch was wired in the

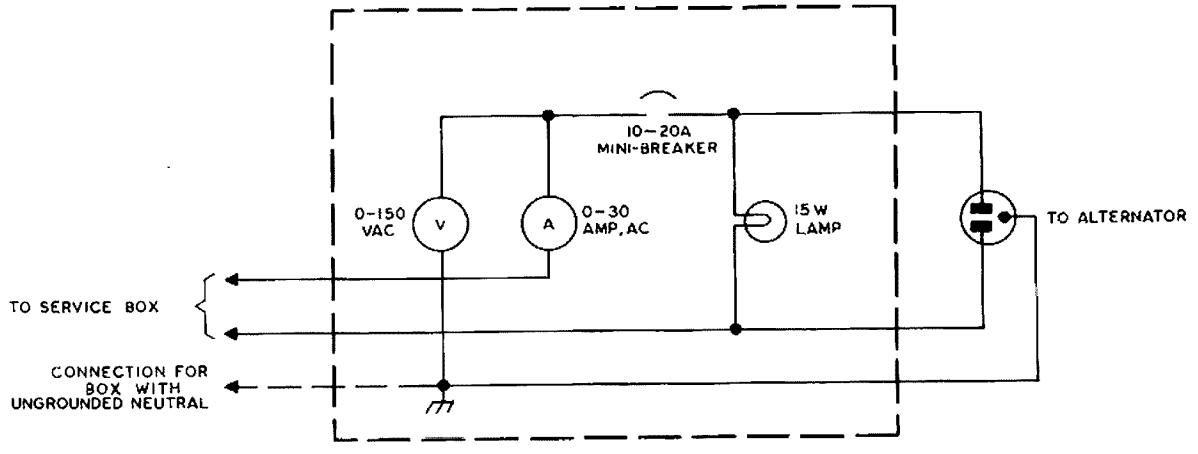
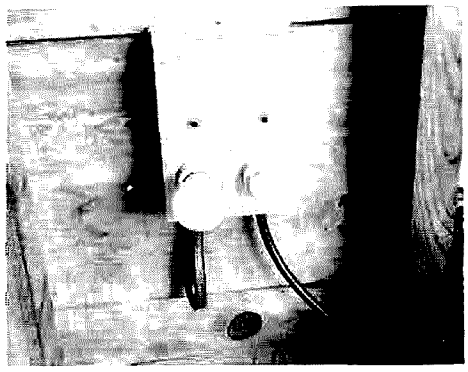


Fig. 3. Alternator panel (optional).



Exhaust wall plate made from 4" junction box cover. See text.



Alternator panel. Voltmeter is on left. Ammeter is on right. The minibreaker screws into a standard fuse holder.

secondary of the transformer to turn the signal off for normal use. A buzzer or bell may be used for a signal. It is not necessary that the transformer be mounted in the box with a fused main as the transformer is plugged in only when the alternator is in use.

The hookups described connect all circuits in the residence to the alternator. A small alternator will not carry all appliances, so a list of appliances to be turned off when using the alternator should be attached to the service box cover.

The second basic precaution is the engine exhaust. Locate the alternator as close to an outside wall as possible, and preferably in the garage of an outbuilding. A small exhaust leak can accumulate lethal quantities of carbon monoxide in a closed area. It is also important to have a free air flow for proper cooling of the engine and alternator. My unit was mounted three inches off the floor to aid in oil changing. A low tone muffler is a good investment. They are considerably quieter than the standard mufflers. A flexible muffler extension for small engines can be made from flexible conduit. Use muffler cement to seal the conduit to the threaded ends. Drill at least a two-inch hole in the wall for the exhaust. A wall plate was made from a four-inch junction box cover with a center knockout.

Two more holes were drilled in the cover for fastening to the wall. Place a pipe coupling against the inside of the plate. The flexible pipe end will thread into the coupling. Turn a pipe nut on a short nipple and thread it into the coupling from the outside and through the knockout hole in the plate. This will hold the exhaust pipe in place. Turn an elbow on the nipple to keep the rain out.

The alternator was fastened to the base with two lag screws. Rubber shock mounts for the lags were made from small sink stoppers.

A control panel was made from a 5 x 7 x 2 inch aluminum box. If meters larger than 2½-inch face are used, a larger box will be required. The panel has an ammeter and voltmeter. The voltmeter is optional. The ammeter is very convenient for checking the load. A minibreaker and fifteen-watt lamp were put in the panel. A flexible lead was made from heavy (14-3 or larger) extension cord to plug the panel into the alternator.

To use the alternator for portable use, remove the lag screws, unplug the cord, remove the elbow, close nipple and flexible exhaust from the engine. This takes about two minutes.

You will find that wiring for the alternator is much more convenient than laying a wire from the alternator to the service box and then connecting it up with alligator clips. Also the family will be able to use it when you are away.

The installation described is for alternators from 1250 to 2500 watts. Smaller units do not have enough output to be worth wiring them into the home electrical system. Larger units are not easily portable (unless trailer mounted) for field day or emergency use.

The new catalog of alternators and supplies arrived after this article was written. Flexible exhausts are now available with standard pipe thread ends in sizes from ½" to 1¼". These exhausts will fit the wall plate described without change.

. . . WA8OIK

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Waldron IN

HIGH POWER MOBILE... THIS TIME THE EASY WAY

Mobiling has always been one of my favorite modes of ham radio. I can remember back in the late forties when I used a low power homemade AM transmitter. My mobile contacts were few and the cost per contact averaged about ten dollars.

Eventually I learned about loading coils, antennas, and mobile power supplies. I began to get good results with my 807, which was later replaced with a 6146. It was about this time that I became employed (previously in school) and I built my first high power transmitter for the 1949 Chevrolet. This final amplifier had four 812s in push pull, was modulated with four 811s and the dc plate supply was an ac 60 cycle power supply using 866 mercury vapor rectifiers. The power source was an old Bendix aircraft 800 cycle alternator that I modified to work from a belt connected to the engine. The centrifugal clutch and carbon pile filed regulator kept the voltage to about 110 volts ac. This alternator also had 24 volts dc available which I used to remotely turn my tuning capacitors with dc motors from the front seat of the car. There were two sets of meters on the transmitter and it was possible to tune the trunk mounted final amplifier from the trunk or the operating position in the front seat. Some wonderful DX was worked from this 1949 Chevrolet but after 130,000 miles and 11 years, I reluctantly removed the rig and bought a new 1960 Chevrolet.

Next I built a small 100 watt 6146 SSB monoband transmitter for this car and I began to see the advantages of SSB mobiling. The results with the 100 watts of SSB was equivalent to the ease of making contacts on the 1000 watt AM rig. Not being satisfied with a single band transmitter I eventually succumbed to a salesman at the used ham equipment counter and brought home a used KWM-1. I could now work three bands and I found my cost per contact had dropped to about one cent. This was quite a change from the beginning.

During the next six years I worked hundreds of stations on the KWM-1 and

hauled it all over the United States. Like all good mobilers, I put off the purchase of a new car as long as possible but in 1966 a new Chevrolet was purchased and the KWM-1 was transferred over.

With a new car and all the experience of high powered mobiling of the past, I began to dream of a KW linear for the car. Eventually Heathkit brought out the HA-14 and I was an early purchaser of the gear with its dc to dc transistor converter. A whole new layer of contacts was possible because of the extra "S unit" which set my signal slightly above the other mobile stations. The Heath linear performed very well as long as the power supply held out. Without going into a long story, it can be said that the power transistors in the power supply could not be made to last. Heath was very generous about supplying free replacements of these transistors, but neither Heath nor I ever really succeeded in solving the problem. I eventually decided to tackle the problem another way. I used the 60 cycle ac supply on the HA-14 and installed an ac inverter in the car. This inverter worked well but eventually the transistors gave me trouble and I was forced to turn to other sources for mobile power.

The old Bendix alternator kept coming back to my mind. I really didn't want to put that monstrosity in the new 1970 (yes another Chevrolet) car so I looked around for another rotating power source.

At the Cincinnati hamfest several years ago I saw a remarkable demonstration of a mobile power source (Don Smith, Fairfield OH). A small ac alternator was belted to an automobile and was electrically loaded with twenty 100 watt incandescent light bulbs. This demonstration ran all day continuously without over heating. The alternator was made by Porta-Power of Sarasota, Florida and was made in several power levels from 3 to 4 KW. The alternator had a transistor field regulator to keep the voltage constant at 120 volts. With the variable RPM of the car, the frequency varies over wide limits but since the alternator frequency is always above 60 Hz there should be no problem with 60 Hz ac power transformers. Contact was made with Porta-Power and eventually I was the proud possessor of one of these rotating beauties. This particular alternator was rated at 3 KW. It was mounted as

It seemed that as I grew more interested in high power mobile transmitters that cars grew smaller. I used to be able to sit straight up in a standard Bel-Air, but in the new 1970 my head hit the roof, my knees had to be in a non-vertical position to avoid the steering wheel, and my knuckles disappeared into the dashboard when I shifted gears. I hate to think how a compact car would fit me. The old KWM-1 still performed perfectly after 300,000 miles and I managed to get it mounted on the transmission hump of the car.

Heathkit was now in production with their new 2 KW SB-220 linear and I knew that this piece of eqiuipment had to be my next high power mobile amplifier. When it came to mounting the SB-220 under the dash it was a different story. I did want to be able to see the meters from the driver operating position so I built a small removable table which mounted on the floor under the dashboard on the XYL's side of the car. I might add that the reader might not find their XYL as agreeable, but my wife, W9CNW, was so brow beaten after passing the Extra Class exam that she agreed to let me do this before she had regained her sanity. Photo 2 shows the story. When we are on the air my occasion-

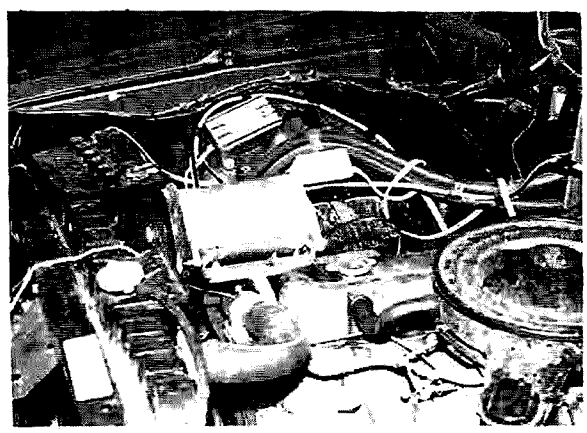
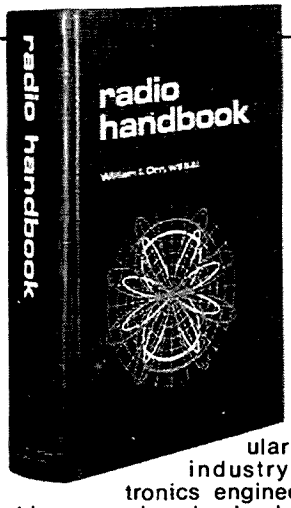


Photo 1. The Porta-Power alternator can be seen behind the radiator and battery. The transistor field regulator is just behind the alternator. The SB-220 is plugged into the 110 volt outlet near the regulator.

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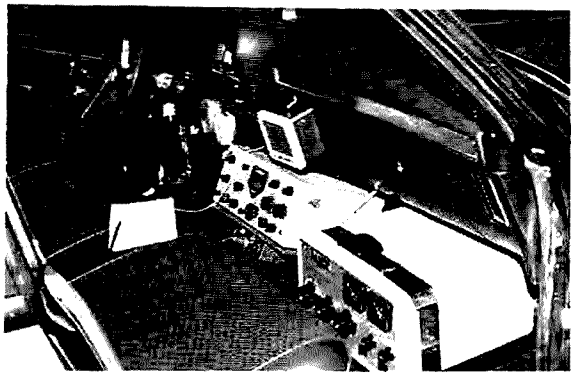


Photo. 2. The KWM-1 and SB-220 are mounted under the dash. The second mike is for the Motorola 2 meter FM fixed frequency two way radio. A common speaker is used for the KWM-1 and FM radio.

al passenger feels somewhat apprehensive when the plate meter reads 3000 volts.

The only modification on the SB-220 was changing the split phase fan motor that refused to turn on the varying frequency of the car alternator. This fan motor was replaced with a 12 volt dc motor which uses rectified ac from a 24 volt filament transformer. The 12 volt fan could have been run on the car's 12 volt system, but I wanted to preserve the ability to run the mobile system on a 60 cycle extension cord when parked at motels.

The results have been all that was expected. DX is very easy to work. I can switch off the linear by a toggle switch on the control box of the alternator. All stations contacted report a change of two S units when the linear is switched off and on. The center loaded antenna is a Master Mobile open coil type. Poor results have always been obtained with other types of loading coils that have solid dielectric. This type heats with rf. No antenna corona discharge problems have been observed.

Mobiling has been particularly good in recent years on Interstate highways. It appears that the metal in the concrete acts as a very good ground plane which gives efficient low angle radiation. Mobilers, let's give those fixed stations some competition. This morning two fixed stations asked two of us mobilers to change frequency. They just couldn't break through our signals.

. . .W9NTP

Bill Hoisington K1CLL
Farover Farm
Peterborough NH 03458

220 MHz: FRONT END USING FET'S

This article describes the design, circuit, and practical working model for the home brewer. One rf, mixer, and channel-crystal L.O. are used. A second similar rf stage may be used as desired.

Today's FET

The protected and insulated dual gate metallic oxide semiconductor field effect transistor, to spell out just what is inside one of those little tin cans, is shown in symbol form in Fig. 1. This device is good for rf amplification up to 500 MHz, which makes it fine for 146, 220 and 432 MHz.

The main features are high gain, high input impedance, large reduction of intermodulation (which is important today with ever-growing band occupancy and climbing transmitter output powers), no neutralization is required, separate inputs for signal and L.O. when used as a mixer, large dynamic range which also helps on nearby signals, protection from transient HV inputs, and last – but not least – easily applied low drive power agc to keep down distortion on stations a few blocks away.

Design

A good practical, stable rf stage for 220, single wire-coupled to another FET as a

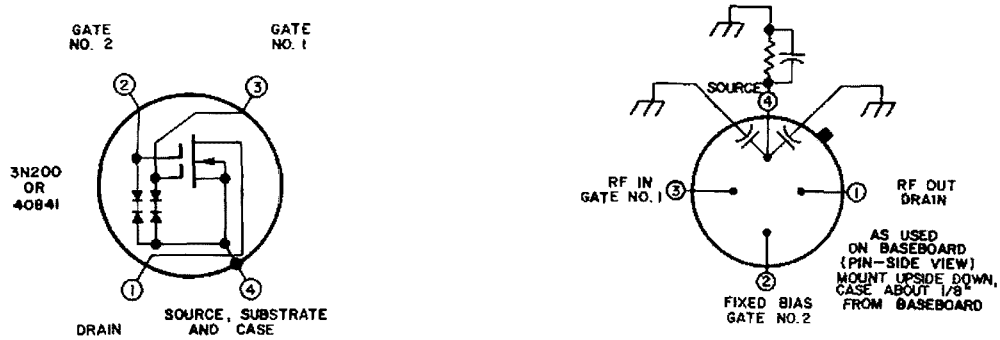


Fig. 1. The 3N200 and its connections when mounted upside down on baseboard.

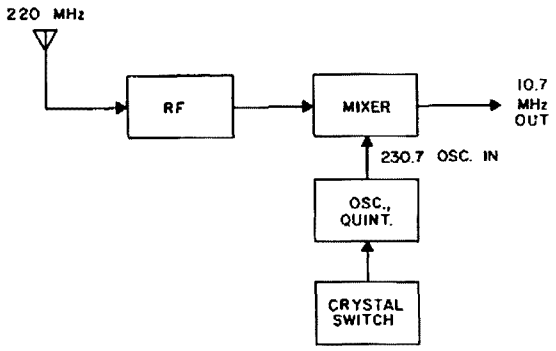


Fig. 2. Block diagram of 220 MHz converter.

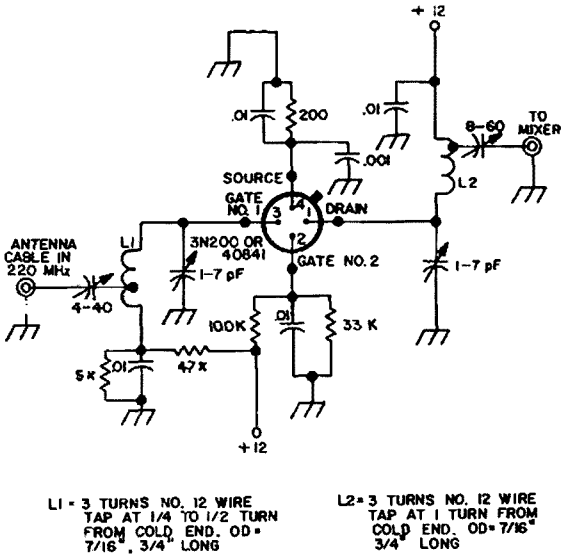


Fig. 4. Circuit of rf stage.

dual-input mixer, and a channel type crystal controlled L.O. are shown. Low cost methods of testing are described, assuming that most do-it-yourselfers, like me, cannot afford signal generators and other test equipment costing hundreds and/or thousands of dollars. This tuner was built and tested with a $30 rf generator and a $14 voltmeter. Because the three are described as separate units and are connected by single wires, no overall schematic is needed (see Fig. 2).

The rf source connection (Figs. 1, 4 and 5) calls for special attention. Use two of the smallest ceramic 1000 (or 10,000) pF capacitors available, about 1/8 in. square, and solder them carefully to the source lead, pin No. 4, as closely as possible to the case. I used Lafayette stock No. 33R69022, to be exact. Then solder one of the capacitor leads to the copper clad baseboard and one to the shield. These leads should tie down the source lead for rf feedback and no oscillation should now occur, even when the input and output are tuned to exactly 220 MHz.

The pictorial layouts shown provide working units and also make good test boards to get together sets of tested and working parts for a final layout. For example, if you wish to make a PC board, or incorporate this circuit into a very small box, the test boards shown allow you to check several sets of components and then, knowing that the coils, capacitors, etc., are correct, install them in the final form chosen. For very small units or PC boards, using pre-tested components also makes for a much neater final job. Every try to modify a PC board?

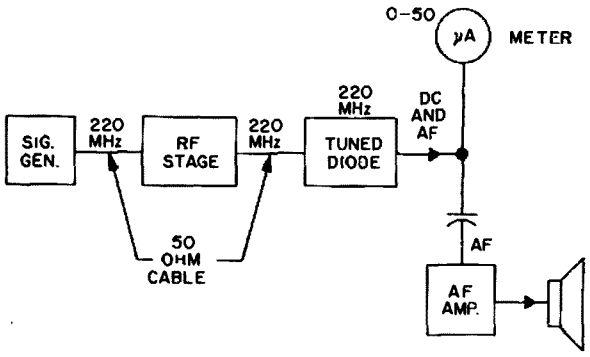


Fig. 3. Test setup for tuning rf stage.

Signal Generator and Test Circuit

The low cost signal generator used here has such a low output on the harmonic used for 220 MHz that it is almost inaudible on a 10.7 diode tuned circuit (see Fig. 3) – without the rf stage, that is. But the amplitude level remains steady, allowing you to build up the stage gains in a relative fashion in good style. Exactly as shown in this article, as in Fig. 3, there is about 4,000 microvolts into the diode which moves the meter in great shape, and the audio signal will drive you out of the shack if you don't turn down the gain. The whole idea of this setup is that you can see everything that contributes to rf gain, conversion to 10.7 MHz in the mixer, matching, and stabilization, which is what you're after here. Also, when everything is tuned and matched correctly, the noise figure will be mainly what the manufacturer says it is. For the 3N200

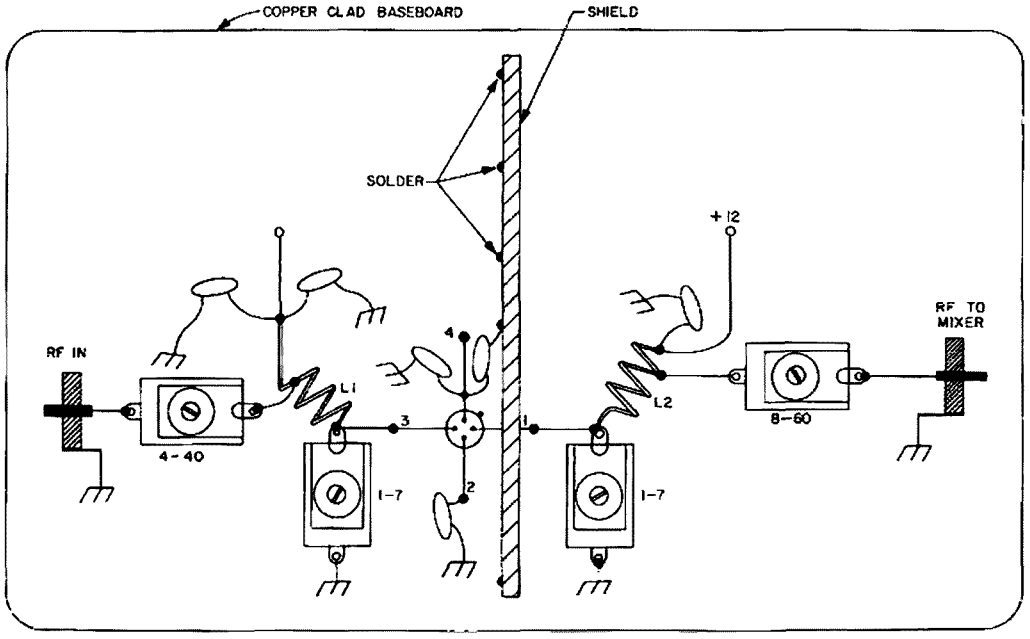


Fig. 5a. Pictorial view of rf stage. Not all parts shown for clarity.

this is somewhere around "typical' 3.9 dB at 400 MHz. For 220 it will be lower and very good. Believe it or not, I can hear radar signals using just one diode for the i-f in the test circuit shown in Fig. 3.

The rf Stage

The schematic is in Fig. 4 and the pictorial layout in Figs. 5a and 5b. This shows the pin view with the signal flowing from left to right. Attention should be paid to the three bias voltages, self bias on the source (similar to a cathode or an emitter) and separate fixed bias voltages on each of the two gates. Bypassing the source is the only real critical point, and if you do it correctly at first you can forget about it from then on. Use several of the smallest available capacitors such as the Lafayette 1,000 pF jobs, which are only 1/8 in. square,

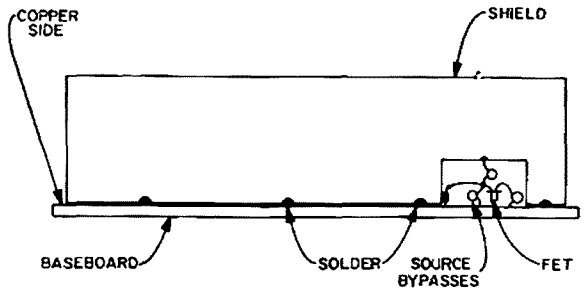


Fig. 5b. Side view of rf stage.

and make the connections no longer than 1/8 in.

Two methods for the input from the antenna are shown because for certain types of antennas one may offer higher gain than the other. Figures 3 and 4 are sufficiently detailed for the rest of the circuit.

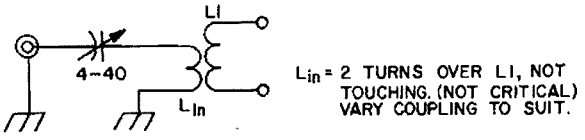


Fig. 6. Alternate rf stage input circuit.

Mixer

There is nothing too critical about this unit, whose schematic is shown in Fig. 7 and the pictorial layout in Fig. 8. Getting the L.O. energy into gate No. 2 must be done with care, however, but once done you can leave it alone. It is important to get *enough* L.O. into the mixer so that you can reduce the amount and still maintain full sensitivity. This means you have some L.O. power to spare, which is good. When you do get sufficient L.O. into the mixer, gate No. 2 dc bias voltage becomes a lot less crticial. The dual gate mixer has shown no tendency to self-oscillate, sometimes a nasty feature with bipolar transistors. Remember, the circuit as shown works well!

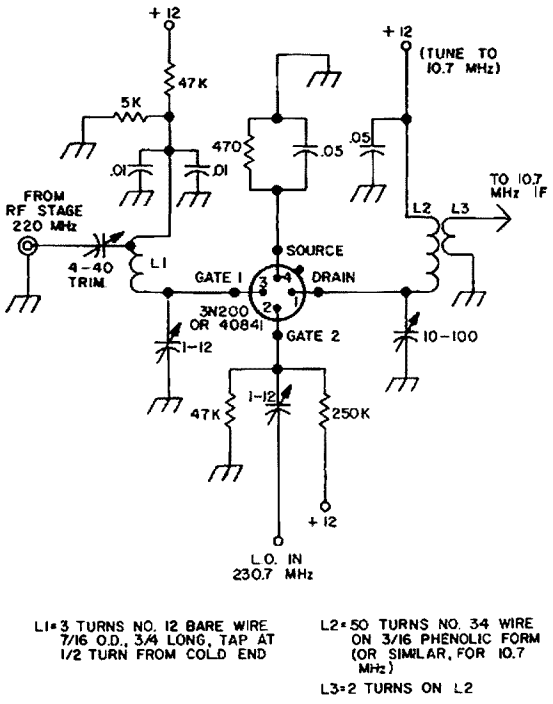


Fig. 7. Schematic of 220 MHz mixer.

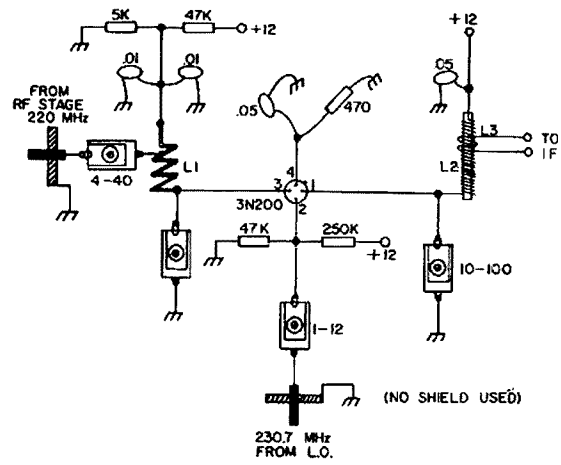


Fig. 8. Pictorial view of 220 MHz mixer.

The Local Oscillator Unit

The schematic is in Fig. 9 and the layout in Fig. 10. This unit, once set up, needs no further attention. After checking the oscillator in the 46 MHz range with a tuned diode, tune the multiplier to 230.7, or a little higher as required by other 220 channels, and that's it. You should get a volt or so rectified dc out of the diode L.O. test circuit shown in Fig. 11. I put in a 2N3866 which is an excellent multiplier in order to get plenty of punch on 232 MHz because the only crystal I had on hand for the 220 band was a 38.667 job, which means multiplying by six. You should order your 220 channel crystals first and use the higher mode (220 plus 10.7). You can get this by quintupling from around 46 MHz, etc. Standard frequency crystals for the 220 FM band channels are shown in the Repeater Bulletin.

You can transfer energy from the quintupler coil to gate No. 2 of the mixer in several ways, but the method shown in Fig. 10 produced the greatest sensitivity. The series coupling capacitor can be used to tune L2. In case it does not, add the optional capacitor shown in Fig. 9. When checking the quintupler for output you should of course use the shunt capacitor to tune L2. Note again that you should have some L.O. power "left over" – otherwise you will not

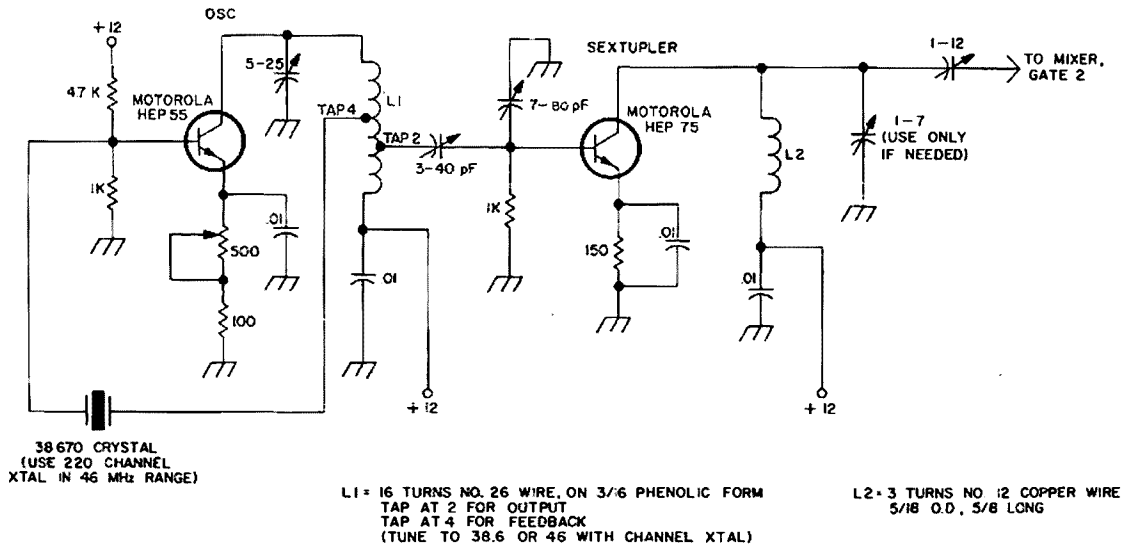


Fig. 9. Circuit of local oscillator chain.

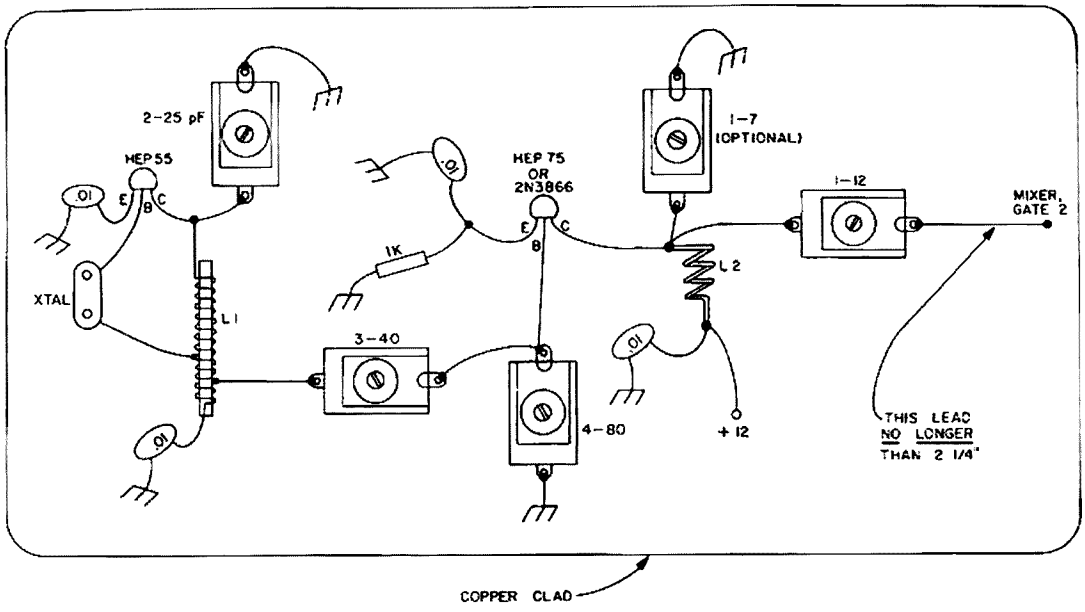


Fig. 10. Pictorial view of oscillator chain. Not all parts shown for clarity.

know if you have enough. You can check this by reducing the quintupler output with a series 1K pot in the emitter of Q2.

The mixer, oscillator and quintupler took about 16 mA at 12V in this unit. The rf stage takes around 6 mA, depending on bias adjustments and the individual FET used.

Figure 12 shows the optional crystal switching and tweaking capacitors that can be incorporated to the circuit of Fig. 9 when you get to where you want to use several channels.

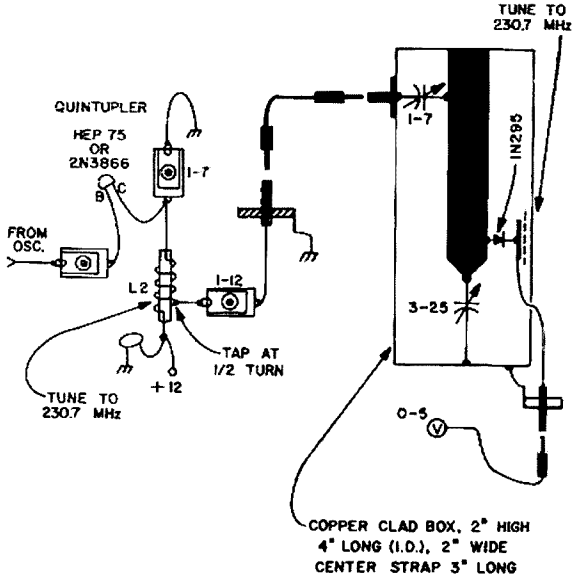


Fig. 11. Diode test circuit for tuning the oscillator circuit.

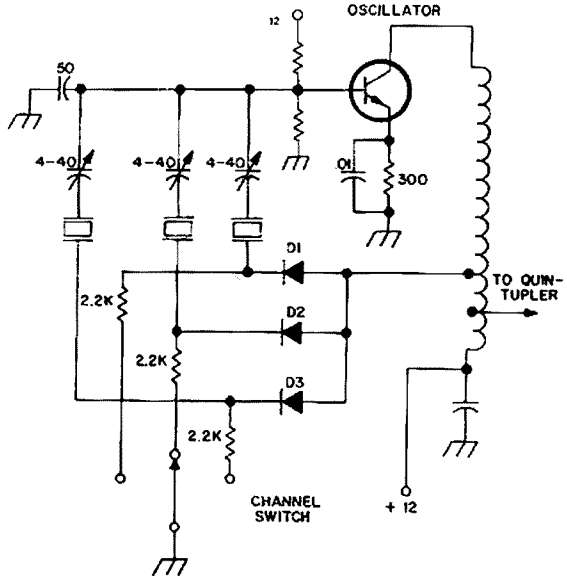


Fig. 12. Optional oscillator circuit incorporating crystal switching and frequency pulling trimmers.

Conclusion

A practical do-it-yourself 220 MHz front end using dual gate FET's has been designed, tested, and described in detail. Built on three separate boards, all components can be checked out in advance for reduction to small size, or PC board work. It is very sensitive, and with just a small vertical dipole you will be able to get acquainted with 220 in your area.

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THE DOUBLE DELTA ANTENNA

The Double Delta is a new and unique design which provides both broad-band and efficient performance on the low-frequency bands for a compact, vertically polarized antenna. The ease of tuning and the simple construction are special features.

During recent years many forms have been developed for reasonably compact low-frequency antennas that would exhibit better efficiency than base-loaded verticals, be reasonably broad-band, and have a more predictable and controlled radiation pattern than random long-wire antennas. Various antenna forms have achieved some combination of these electrical qualities, but usually their forms were such as to pose many constructional problems. One example would be low-frequency cage-type vertical antennas. The cone shaped cage requires at least 8 to 16 radial wires, and the open end of the cone must be at the apex of the antenna structure and not at the ground end. Also, a good ground radial system is required for efficient operation of such an antenna.

This article, however, describes a new and unique type of compact low-frequency antenna design which combines many of the features of previous designs but yet is very simple to construct and can have a wide range of physical dimensions. No inductive loading is used in the design, it is reasonably broad-band (over two low-frequency bands with reasonable antenna dimensions), it can be fed with any common transmission line, it has an omnidirectional radiation pattern and the efficiency is good (again with reasonable antenna dimensions) without the use of a ground radial system. Although the design can certainly be used for any fixed station operation, its ease of construction and erection makes it particularly applicable to portable operations.

Basic Design

The design of the antenna, nicknamed the

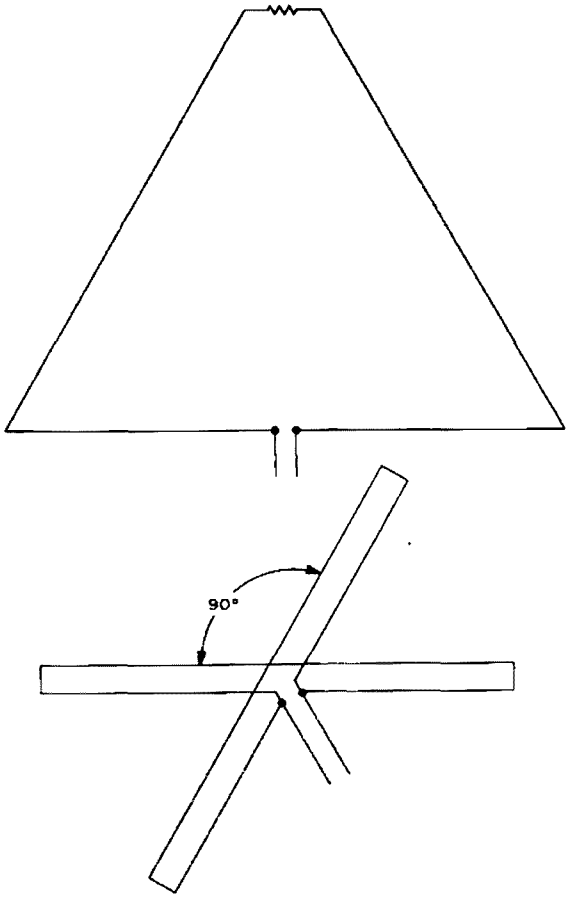


Fig. 1. The Double Delta antenna is basically a combination of a vertical half rhombic design (A), frequently called a delta antenna, and a turnstile antenna (B) made from folded dipole antennas.

Double Delta, was not simply "pulled out of the hat" but is based upon two well established and proven antenna forms. Figure 1 shows these forms. The antenna forms of Fig. 1 (A) may not appear immediately familiar, but it is really just half a terminated rhombic antenna which is vertically oriented, and is frequently referred to as a Delta antenna. It radiates mainly at high radiation angles, and is particularly useful for short-skip work on the lower-frequency bands. In its proper rhombic form and to provide some directivity and gain, the dimensions of the antenna have to be fairly large – at least a 60 ft center height on 40 meters, for instance. However, because the terminating resistor makes the antenna non-resonant, it will accept power over a broad range of frequencies even when its physical dimensions are contracted. The terminating resistor value must only be chosen for given physical dimensions of the antenna. The radiation pattern of the antenna will change as its dimensions are reduced to the point where a small loop configuration is reached. Generally, the vertical plane radiation pattern becomes much broader, and for a given loop or delta size on a given frequency, the horizontal plane radiation may be mainly broadside or in line with the physical plane of the antenna. Such an antenna could be used alone with reduced dimensions, but one real disadvantage would be the radiation pattern change with frequency.

The antenna form of Fig. 1 (B) is that of a conventional turnstile antenna which consists of two half-wave folded dipoles phased so that an omnidirectional horizontal radiation pattern is produced. The necessary phasing is often done with a separate phasing line, but it can also be done by proper interconnection of the dipole feed terminals as shown. When done in this manner, the phasing will remain correct over whatever range the basic dipole antennas can be operated.

Figure 2 shows how the basic two foregoing antenna ideas are combined to form the Double Delta antenna. As can be seen, it

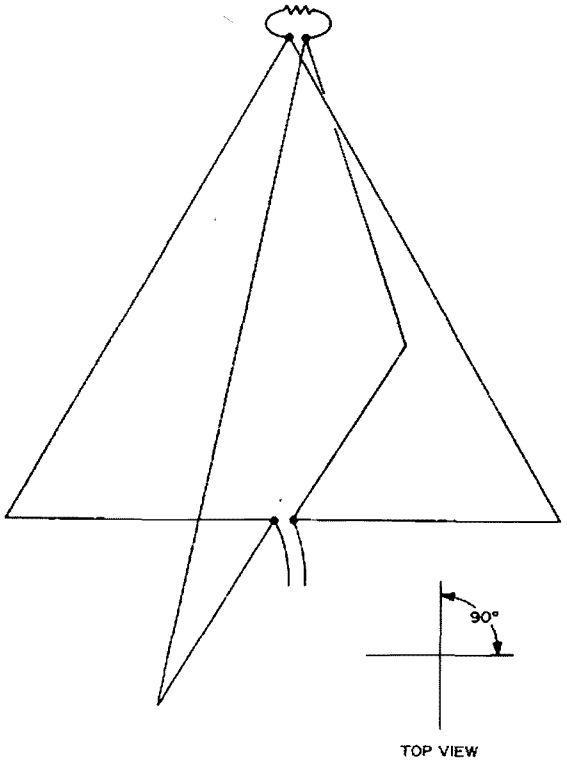


Fig. 2. The Double Delta consists of two Delta antennas placed at right angles to each other and phased in a manner similar to a turnstile antenna.

consists of two single Delta antennas oriented and phased like the dipole antennas in a turnstile configuration. Although the radiation pattern of the single Delta antenna will change with frequency (depending upon dimensions), the turnstile type phasing makes the Double Delta retain an essentially omnidirectional radiation pattern. The use of two Delta antennas further broadens the frequency bandwidth of the overall antenna system. Although a separate terminating resistor could be used in each Delta, the use of a single resistor was found to be sufficient.

No specific dimensions, even in terms of wavelength, was mentioned in the foregoing discussion because, in fact, no hard and fast dimensions can be given. The following section of this article describes a Double Delta antenna which I constructed for use on 80 and 40 meters, but the dimensions shown are by no means the only possible ones. Although studies could not be made of a large variety of antenna dimensions, it would appear that good efficiency will be achieved as long as the total *lineal* length of each Delta element (sides plus bottom section) is made about ¼ wave on the lowest frequency band to be used. The antenna will work with shorter dimensions, but the efficiency will suffer. Probably an absolute lower limit would be to make the lineal length 1/8 wave at the lowest operating frequency. Even with these restrictions, the antenna height required is only a fraction of that of other designs. The ratio of total base length to height (not side length) at the center should not be made greater than a 1:1 ratio. This great latitude in choosing the antenna dimensions is partly possible because the terminating resistor can be "tailored" to suit a given impedance transmission line, and one is not dependent solely upon the antenna configuration to establish the feed point impedance.

Practical "Double Delta" Example

Figure 3 shows the dimensions of one "Double Delta" design which I tried for 80 and 40 meter operation. The total lineal length of each Delta was made about ¼ wave on 80 meters. The base length to height ratio was chosen such that the height was about

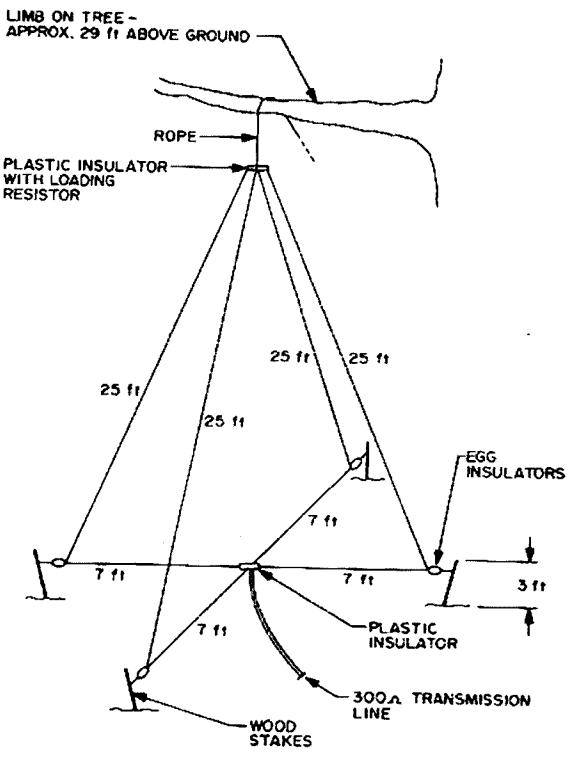


Fig. 3. Dimensions of a Double Delta antenna which was tested. Coaxial transmission line can also be used as explained in the test.

27 ft in order to allow simple erection of the antenna via a rope support around a high tree trunk.

The antenna was constructed of ordinary stranded antenna wire with egg insulators attached to wooden stakes, driven in the ground, used to place the two Delta triangles at right angles to each other. Special plexiglass insulators were fabricated to join the wires at the apex of the antenna and at the base where the transmission line is joined to the antenna. Probably many other schemes can be used for these insulators, but the plexiglass types are simple and inexpensive to fabricate. Details of the construction of these insulators is shown in Fig. 4. The upper insulator joins the individual Delta elements in a criss-cross fashion with the non-inductive type terminating resistor mounted on one side of the plexiglass insulator and connected by jumper wires to the Delta elements. A hole was drilled in the center of the insulator and ¼ in. nylon rope knotted underneath the insulator for use as a support line. The bottom insulator is basically the same as the upper insulator, except that the jumper wires for the Delta elements

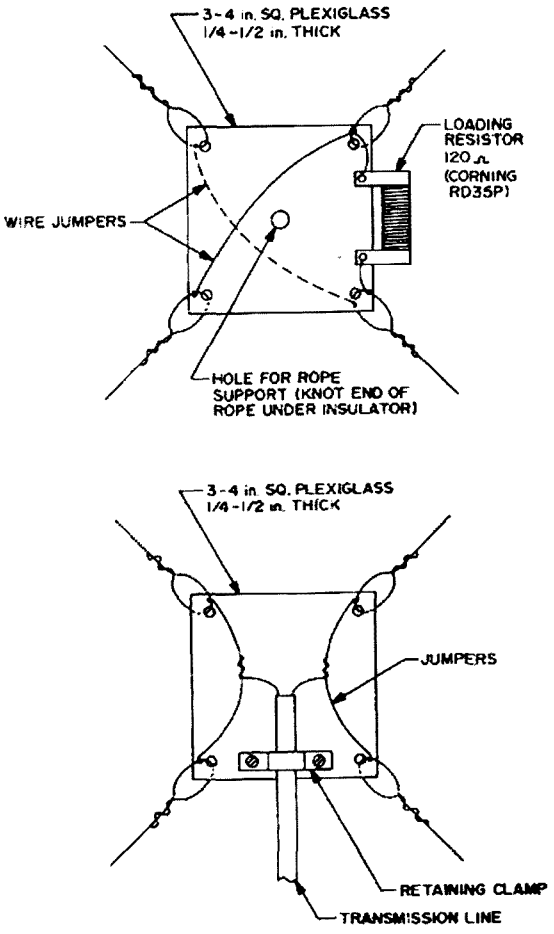


Fig. 4. Details of the upper (A) and lower (B) plastic insulators for the antenna of Fig. 3.

are wired directly from edge to edge. The transmission line used is soldered to the jumper wires and the cable held in place on the insulator by means of a metal or plastic clamp.

Although a 300Ω transmission line was used, any common impedance transmission line, including coaxial types, can be used by properly choosing the value of the terminating resistor. Using 1 or 2 watt carbon composition resistors as test resistors, the value of the terminating resistor can be found which produces the lowest transmission line swr over the desired operating range. Only a few watts of tranmitter power output should be used for these tests (enough power to properly set the swr meter) and then a 25–75 watt resistor substituted for operation at full transmitter power. The wattage rating of the terminating resistor depends upon the dimensions of the antenna, but a safe approach would be to choose a resistor with a wattage rating equal to at least ¼ of the power input of the transmitter used. The 25 watt resistor used with the antenna shown showed no signs of overload when used with a 150 watt transmitter on SSB.

Performance Results

Swr measurements made on the antenna of Fig. 3 showed an swr of less than 2:1 across both the 80 and 40 meter bands. It probably would be possible to further reduce the swr on any one band by more careful selection of the terminating resistor. The total bandwidth of the antenna was not determined, since only 80 and 40 meter operation was of interest. However, there is a good possibility that when properly configured the antenna can be used as a tri-band affair. The only possible disadvantage to such operation is that as the Delta elements become larger in terms of wavelength, one may approach the original vertical half rhombic design with its very high radiation angle.

Comparison tests of the Double Delta design against a base loaded 23 ft vertical made of tubing consistently showed the Double Delta to produce stronger signals on the order of ½ to 2 "S" units.

Summary

The Double Delta shows good promise of being a very useful and simple antenna for use on the low-frequency bands. No claim is made that the optimum dimensions for the antenna have been determined, but the results achieved certainly indicate the validity of the basic design.

Many variations on the basic design suggest themselves, especially if one were interested only in single-band operation. for instance, going back to Fig. 1 (A), one could use a variable capacitor to resonate the antenna "loop style" on a particular frequency. the Double Delta of Fig. 2 could then be constructed with a resonating capacitor in each Delta. This would increase the antenna efficiency by eliminating the dissipation loss in the terminting resistor. However, one would have to accept the feed point impedance thus produced and use a matching network, if necessary, at the feed terminals to couple to a transmission line.

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Product Review:

TEMPO FMP

Have you ever had the desire to carry your FM rig at your side to keep in touch with the gang on the local repeater? The Tempo FMP is a convenient way to do it. You can use it over your shoulder or in your car or in your home. Dollar for dollar, it contains many features not found in other rigs.

This little jewel has two power levels. There is the battery saving half-watt out and the fringe fighting three watts out. The half watt is perfect for local direct work or if you are high up in your hotel while traveling. The high power position is great for making the repeaters that seem to be installed on the outskirts of all cities. The high power position is more than adequate for driving amplifiers that require one to two watts of drive. The self contained batteries are C cells that can stand high drain for periods of time. There is even a little switch on the front panel that allows you to change the meter from a S-RF meter to a battery monitor. When you put it in the monitor position, a little pilot lamp is turned on and the meter is illuminated. Besides keeping meters off the batteries and producing a slight drain, you check the battery condition only when needed. The little pilot light is also perfect for lighting up a small area so that you can read your logbook.

There are more channels in this portable rig than there are in some of the available base station rigs. The crystals for the channels are very easily reached. Jumping is simple because there is a lot of room for even the stubbiest of fingers to get in with a soldering iron. All crystals can be trimmed right on frequency. With eight possible channels, you have convenience and versatility. Leave channels one through five for your local work and six, seven, and eight for the channels in the areas that you visit most frequently. Or if you live in the crowded Boston and New York and Los Angeles areas, all eight channels will be filled up for local work.

It may be hard to conceive getting your whole hand into a tiny rig that you can carry around with you, but it is true. The rig comes in two sections that are snapped together. Shades of the low bands, the power and rf units are separate! The batteries and speaker are mounted in the lower box and there is a cable interconnecting the two units. Audio and other leads can be tapped here. There is room for an ac power supply, battery charger, tone burst assemblies, and more in this section. And it is still tiny. The rf unit has the printed circuit boards for the transmitter and receiver and all switches and controls: power, volume, squelch, power level, meter switch, and channel selector. This unit is a little less than half the total size of the whole FMP. You can carry the FMP over your shoulder in its leather case or you can lay it flat on your desk or mount under the dashboard. The antenna connects with a twist on the front panel BNC antenna connector. The FMP is supplied with a quarter wave whip from which kinks may be quickly removed even if you fall on top of it. The shape of the rig is rectangular but with a slightly sloping front panel that leans the antenna away from your body and it also lets the rig look up at you if it is under the dash or on your desk. It looks sharp wherever you leave the radio.

The portable FM transceiver, watertight leather carrying case, and excellently written instruction book costs only $225 from Henry Radio and their distributors. Isn't that a low price for such fun?

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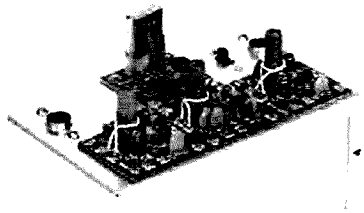
A Simple Converter for Beginners

USING EXPERIMENTER'S MODULES

Want to build a converter for any frequency from 3 MHz to 170 MHz? The International Crystal Company experimenter kits can be selected and assembled to make any input and output combination in this range.

A brief explanation of how a converter works will help you understand the functions of the stages. Assume we want to listen to the 20 meter (14.00–14.35 MHz) band and we have an 80 meter (3.5–4.0 MHz) receiver. Our problem is to convert the 20 meter band to the 80 meter band. Subtracting 14.0 – 3.5 we get 10.5 MHz. Note that the 20 meter band is .35 MHz wide. Adding this to 3.5 we get 3.85 MHz. Logically, if we subtract 14.35 – 3.85 we again get 10.5 MHz. We have this constant 10.5 MHz difference at any corresponding points on the bands. If we make an oscillator with 10.5 MHz output and mix it with 14.0 MHz we can produce a beat frequency or difference of 3.5 MHz. Again, any corresponding points on the two bands will have a difference of 10.5 MHz. From this we find that by using a converter we can tune our receiver 3.5 to 3.85 MHz and listen to 14.0 to 14.35 MHz.

We could make a converter with only a mixer and oscillator, but it would have some faults that would limit its usefulness. The first and most obvious is that the 10.5 mixer, or injection, frequency plus the output frequency 3.5 MHz gives us 14.0 MHz which is the desired frequency – but at the same time we have 10.5 MHz minus the 3.5 MHz output frequency which is 7.0 MHz – so we would also be receiving the 40 meter ham band at the same time. This undesired frequency is called the image frequency.



To receive only the 20 meter ham band we need a tuned circuit that will amplify the 20 meter band and attenuate the 40 meter band. To do this we add a tuned rf amplifier stage between the antenna and mixer.

We produce the injection frequency with an rf oscillator. This can be a typical Hartley or Colpitts LC (tuned coil-capacitor) controlled oscillator or a crystal controlled oscillator. The advantage of an LC oscillator is that the injection frequency is easily changed. An adjustable coil or variable capacitor will permit changing the frequency at will. The disadvantage is that it is not as frequency stable as the crystal controlled oscillator. Frequency stability is the advan-

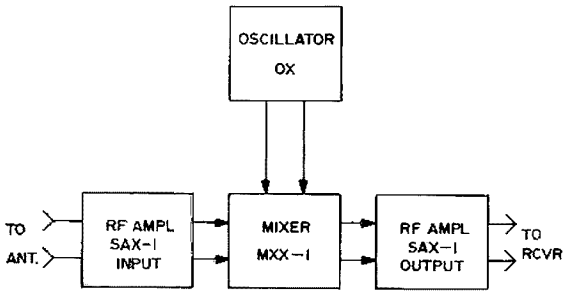


Fig. 1. Block diagram of converter.

tage of the crystal controlled oscillator. The disadvantage is that a new crystal must be purchased to change frequency. This injection or local oscillator frequency is coupled to the mixer where it mixes, or beats, with the signal frequency and produces the output frequency (and image). As the signal input to the mixer is quite small, only a weak injection frequency is required – usually not more than a few mW. You cannot increase the gain of a converter by increasing the injection frequency strength.

We can further improve the gain and signal-to-noise ratio by adding a tuned stage after the mixer. This is an rf amplifier tuned to the output frequency or 3.5 to 3.85 MHz in our example.

We are now ready to begin construction. Refer to the block diagram of the converter (Fig. 1) and Table I to determine the kits to use for the band you want to listen to.

Prepare a 5¼ x 3 x 2 1/8 in. aluminum minibox as shown in Fig. 2. There is room to use any type antenna and output connectors you want. I used Motorola jacks. The switch can be slide or toggle. The miniature imported switches work very well.

Assemble the printed circuit kits with the following changes: The connector pins are inserted in the printed circuit boards when you get them. Carefully push these pins out and reinsert them on the foil side. This will put all wiring inside the minibox and make a neater job. Refer to the charts supplied with the kits for coil and capacitor combinations for the frequency you want. There are several coils and capacitors with each kit. When you insert and solder the coil and capacitor do not bend the coil tabs or capacitor wires. This will permit easy removal if you want to change either for a different frequency.

Table I: Converter Components

INPUT RF AMPLIFIER

To receive signals 3 to 20 MHz use SAX-1 LO
To receive signals 20 to 175 MHZ use SAX-1 HI

MIXER

Converter input 3 to 20 MHz use MXX-1 LO
Converter input 20 to 175 MHz use MXX-1 HI

OUTPUT RF AMPLIFIER

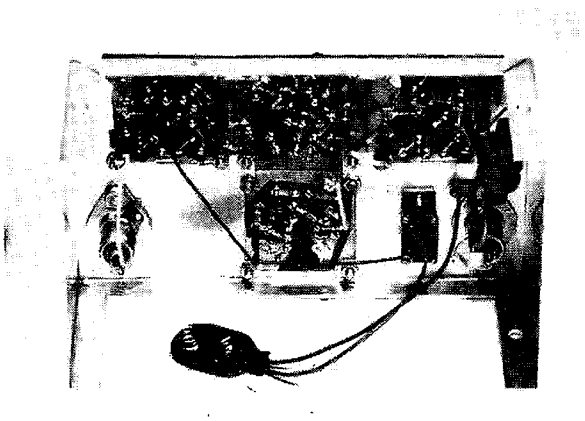
Output to receiver 3 to 20 MHz use SAX-1 LO
Output to receiver 20 to 60 MHz use SAX-1 HI

OSCILLATOR

Subtract output frequency from input frequency
If difference is 3 to 20 MHz use OX LO
If difference is 20 to 60 MHz use OX HI
If difference is over 60 MHZ divide by 3 and mixer will work on third harmonic of oscillator OX HI

CRYSTAL

Same frequency as difference in input-output above. If difference is over 60 MHz order crystal for 1/3 of frequency difference.



Keeping the above notes in mind, assemble the kits following the directions. The same interconnections and power connections are used with all kits regardless of frequency. The converter I assembled was for 2 meters with a 28 to 32 MHz output. I used two SAX-1 HI rf amplifier kits. One MXX-1 HI mixer kit. One OX HI oscillator kit with a 38.6667 crystal (the crystal is not supplied and must be ordered separately. For the input rf amplifier I used the green dot coil and 6.8 pF capacitor. All the coil designations and capacitors referred to will be from the charts supplied with the kits. The mixer also used a green dot coil and 6.8 pF capacitor. The output is a red dot coil and 47 pF capacitor. The oscillator has a red dot coil and 28 pF capacitor. Slugs were used in all coils except the oscillator coil (there is a further note in the summary about this coil). Make the links from instructions in the charts. The schematic of my converter is shown in Fig. 3.

Mount the kits on the minibox. The mounting screws supplied with the kits are quite long. 4-40 x ¼ in. screws will be neater. Mount the kits so the inputs and outputs line up for minimum connector length. With the three cutouts in front and the oscillator cutout behind, the signal input kit is mounted with the In and Out to the left, rf OUT LINK to the right. The mixer is mounted with the rf IN and GND to the left, GND and OUT to the right. The rf output amplifier is mounted with IN and GND to the left, rf OUT LINK to the right. The OX kit is mounted with the crystal socket to the rear and parallel with the long dimension of the box. Use the press-on connectors for interconnections so the kits can be easily removed if desired.

Step-by-step interconnections follow. If there is a number by the word solder it indicates the number of wires to be soldered at that terminal.

A wire from the antenna jack (solder) to IN connector on input SAX-1 (solder)

A wire from the HI rf OUT link on SAX-1 (solder) to rf IN on MXX-1 (solder)

A wire from LO rf link on SAX-1 to rf GND on MXX-1 (solder)

A wire from rf on OX (solder) to OSC IN on MXX-1 (solder)

A wire from GND on OX (solder) to OSC GND on MXX-1 (solder)

A wire from OUT on MIXX-1 (solder) to IN on output SAX-1 (solder)

A wire from GND on MXX-1 (solder) to GND on output SAX-1 (solder) (note these wires cross, be sure they don't touch)

A 2.5 mH rf choke from HI rf OUT link to LO rf OUT link (solder) on output SAX-1

A .001 mF capacitor from HI rf OUT link on output SAX-1 (solder 2) to converter output jack (solder)

This completes the rf wiring. The remaining wiring is for power to the units.

A wire from one terminal of switch (solder) to 6V on OX

A wire from 6V on OX (solder 2) to + dc on input SAX-1

A wire from + dc on input SAX-1 (solder 2) to + dc on MXX-1

A wire from + dc on MXX-1 (solder 2) to + dc on output SAX-1 (solder)

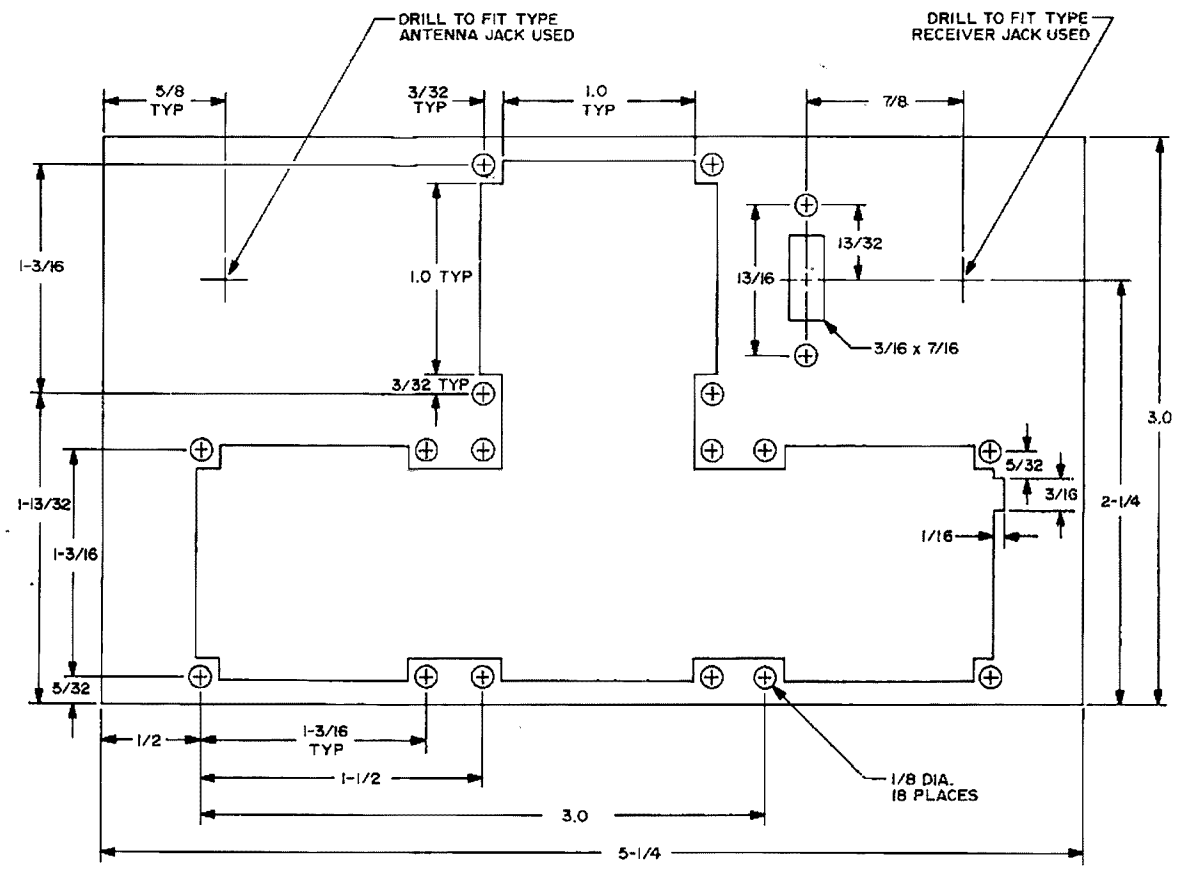


Fig. 2. Template of converter chassis.

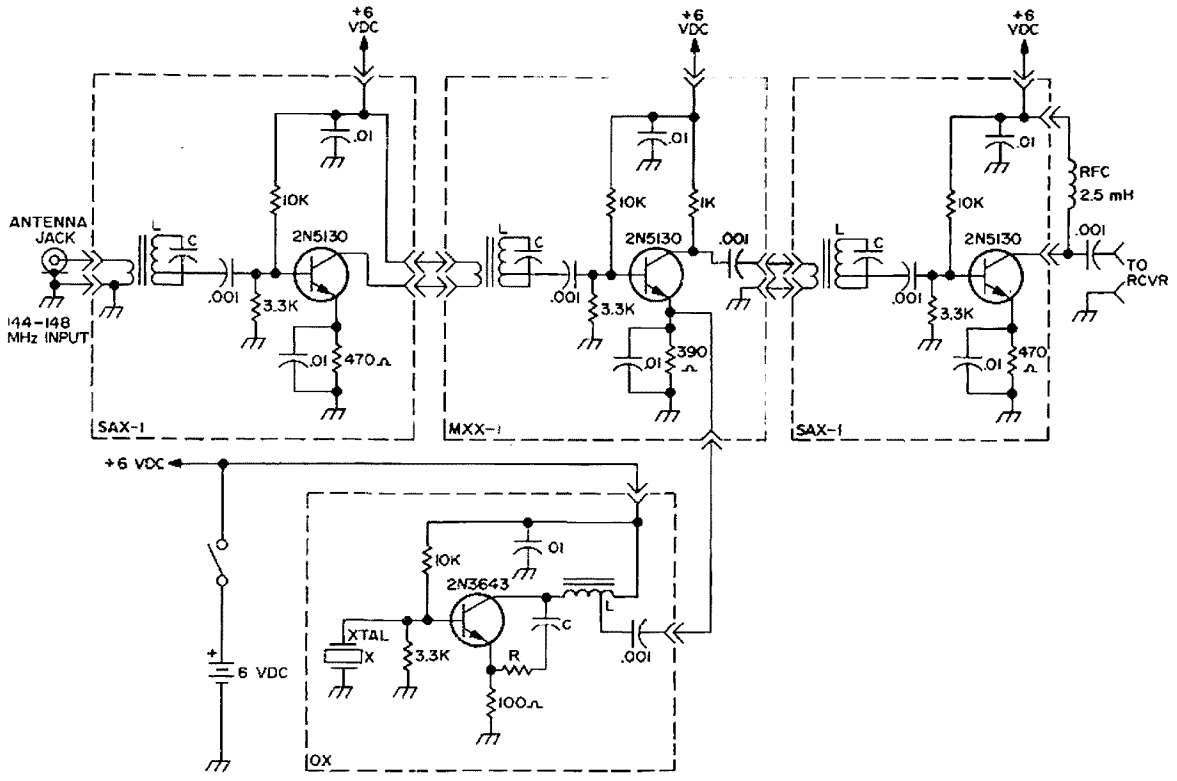


Fig. 3. Block diagram of converter showing overall circuit.

Battery connector leads Black to GND on OX (solder) red to switch (solder)

This completes the wiring. Check all connections to be sure they are correct.

Turn switch off and connect battery. Insert crystal. Center all coil slugs (use a plastic alignment wrench, a metal wrench will affect the tuning). Connect converter to receiver with short piece of coax. Connect converter to signal generator or antenna. Be sure receiver is on correct band. Turn converter on and tune receiver for signal or tune signal generator to correct frequency. When a signal is heard, tune each slug, starting with the signal input coil, for maximum signal. Your converter is now completed.

Some of the frequencies that can be tuned with this convertor are close to the edge of a frequency range for a particular coil and capacitor. If it is and you find that when tuning the coil slugs the signal is still increasing when you reach the bottom of the coil form with the slug, replace the capacitor with the next larger capacity supplied with the kit. If the signal is increasing as the slug is turned all the way out, use the next smaller capacity. Conversely, you could use the higher and lower frequency coils. You should be able to tune through maximum signal strength with the correct coil-capacitor combination. A slug can be used in the OX kit when not specified, if you have the equipment to check maximum oscillation, by using smaller capacitors than specified.

The rf choke in the converter output circuit can be replaced with a coil-capacitor that will tune the output frequency. However, the rf choke and capacitor are satisfactory as is, and no tuning or changes are *required* for any output frequency.

The converter is simple and you can try some of the suggestions in the notes to learn more about converters. The tuning is so simple that if you get "lost" and cannot receive a signal, just go back to the original coil, capacitor and slug tuning and you will be back in business.

There are fine articles in 73 on the construction of converters that will give outstanding performance. After you get familiar with a simple converter – like the one described – you should have less apprehension about building one of the state-of-the-art converters. The only basic difference will be higher 'Q' coils and more tuned circuits with the necessary shielding and bypassing.

...WA8OIK

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THE THIRD HAND..... TESTER

A portable impedance bridge, crystal calibrator, field strength meter, etc.

When was the last time you hung on the tower or in a tree trying to couple your dip-meter with one hand to the bridge which was in the other hand while hanging on with the third hand - not to mention the problem of how to turn the dials while untangling the extension cords (if you had enough to reach) and other associated problems.

The following are construction details for a 3" x 5" battery operated, self-excited built in rf source impedance bridge. With just a little extra effort you can also have a field strength meter with tuned input or use as a band spotter when using crystals at other than their fundamental frequency. You can also check crystals in the 1 to 30 MHz range for activity In addition, with a 1 MHz crystal you have a handy dial calibrator or rf signal source for general allignment and peaking of receiver circuits.

The circuit is a common impedance bridge coupled to, and driven by a built-in

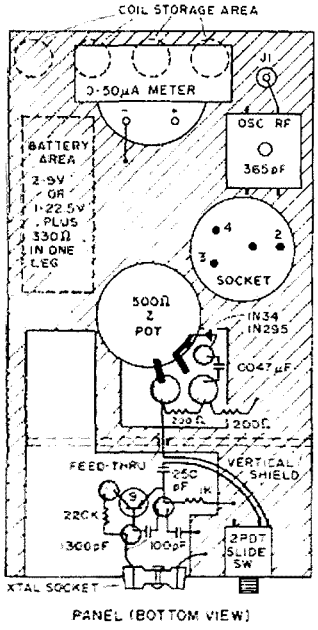


Fig. 1a Circuit board layout. Meter – 0-50μA from mail order listed as light meter movement; 365 pF variable – from old transistor radio socket & coil form allied radio D1899 45d transistor GE9; J1 – pin jack for field strength meter whip antenna.

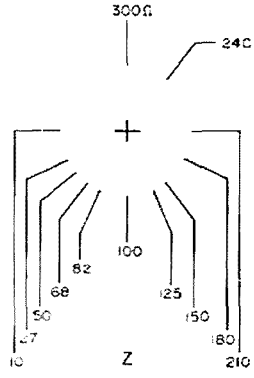


Fig. 1b. Impedance dial scale.

un-tuned crystal oscillator. Any fundamental crystal between 1 and 30 MHz will drive the 50 μA meter to full scale. Inserting an unknown impedance in pins 1 & 3 of the test socket will allow you to read the impedance on the calibrated dial. Should it be convenient to drive the bridge with an alternate rf source such as the transmitter or an rf generator, merely leave the power switch off and inject the rf into pins 2 & 1 of the test socket (pin 1 is ground). Connect the unknown impedance to pins 3 & 1.

To check crystal activity, install the crystal, turn the power on and the relative crystal activity will be indicated on the meter.

To use the tester as a frequency spotter or rf source for alignment plug in the crystal, turn on the power and put a whip antenna in pin 3 of the test socket. For maximum rf output set the impedance dial to 0Ω.

To operate the tester as a field strength meter leave the power off and install a whip antenna in pin 2 of the test socket. For greater sensitivity or band spotting leave the power off, install the whip antenna in the pin jack, and insert the coil for the frequency to be checked in the test socket. Adjust the 365 pF tuning capacitor for a maximum meter indication.

Construction

The complete unit is housed in a 3" x 5½" mini-box. A circuit board may be etched to provide the six islands needed or phenolic vector board may be utilized and solder pins installed in the six locations indicated. The mini-box top is cut away to accommodate the circuit board.

The crystal socket and power switch are mounted on the box end to minimize lead length. The 500Ω potentiometer has one outside terminal cut off to eliminate interference with the diode and .0047 capacitor. If the component placement and lead length and values are as shown, the impedance dial calibration scale provided should be reasonably accurate. A final calibration may be made by inserting precision resistors in pin 1 & 3 of the test socket and comparing the null obtained to the dial readings.

The whip antenna is a replacement type available for transistor radios. Obtain a broken TV rabbit ear from the local repair shop (lots of 'em) and solder a pin jack to the broken end. Hint – file away the chrome finish before attempting to solder.

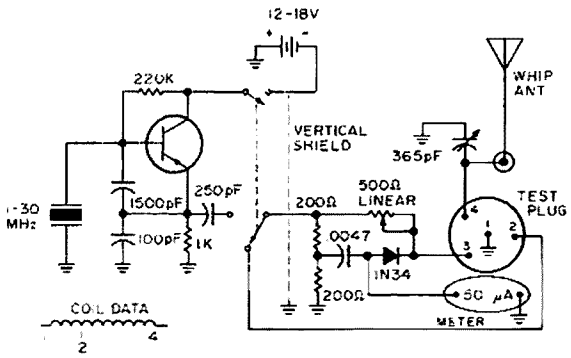


Fig. 2 Schematic 3 – 7.5 MHz 35 turns No. 24 tap 12 T. from ground end. 6 – 14 MHz 20 turns No. 24 tap 7 T. 13 – 22 MHz 11 turns No. 24 tap 4 T. 21 – 30 MHz 6 turns No. 24 tap 2 T. All coils on Calectro G-C No. DI899. Available from Allied Radio Corp. Meter 0-50 μA. Available through mail order houses as light meter movements. CHEAP! 365 pF tuning capacitor is from an old transistor radio. Don't use the oscillator section or frequency coverage will be higher than indicated. Transistor – GE9 or similar. The power/function switch is a slide type 2P2T miniature. Whip antenna: rabbit ear or similar device (see text).

As indicated on the schematic, two 9V batteries may be used for power or one 22½V battery with a 330Ω series resistor in one lead. Current drain is approximately 8 mA.

Four plug-in coils are needed to cover the range of 3 to 30 MHz. Using the coils specified you will find ample room inside the mini-box to store the coils vertically when they are not needed. To secure the coils I merely cemented a piece of foam rubber to the cover and standing the coils up allows the pins to rest in the foam when the cover is installed.

A standard fuse holder (open type) was mounted on the outside of the box and makes a convenient holder into which the whip antenna may be snapped. Should you desire real accuracy from the 1 MHz crystal for dial calibration purposes, the 100 pF capacitor off the transistor base may be made variable and the crystal can be beat with WWV. Considerable adjustment may be made without effecting rf output or frequency range of oscillation.

. . .WB4MYL

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HIGH STABILITY "LUMPED LINE" OSCILLATOR

Many self-excited oscillator circuits have stimulated the interest of the designer and constructor. Each of these can be readily optimized for a particular performance feature, or exploited for some practical advantage. When frequency stability commands high priority, the Clapp oscillator is likely to be the chosen circuit. Although it has been shown that the attributes of the Clapp circuit can be attained by directing special design approaches to other configurations, the fact remains that frequency stability is a readily forthcoming operating feature of the practical Clapp oscillator. It is for this reason that this circuit is so frequently used as vfo in both amateur transmitters and commercial equipment. When one considers the extent and tenure of the popularity enjoyed by the Clapp oscillator circuit, the question naturally arises, "Does the possibility exist for further upgrading of self-excited oscillator performance?" In the exploration of such a possibility, we would not be concerned with such techniques as temperature compensating components, regulated power supplies, feedback limitation, etc. These performance-enhancements can be applied to *any* oscillator circuit. Rather, we would like to see a new or modified approach which would possess inherent virtues *prior* to application of such compensation and optimization methods.

In seeking to displace or improve the basic Clapp circuit, it is only apropos that we first cite some of its real or alleged shortcomings. The most obvious one is likely to receive the least attention because of general acceptance as the "nature of the beast." In the Clapp, as well as in all other self-excited oscillators employing L-C frequency determining "tank" circuits, oscillation frequency is profoundly susceptible to conditions associated with the inductor. This sensitivity includes turn-spacing, dieletric between turns, moisture, dust, temperature,

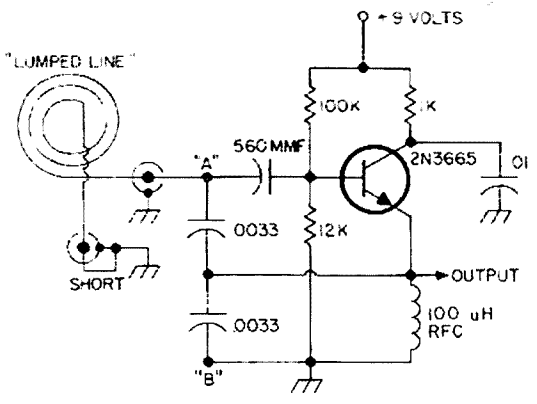


Fig. 1. Basic "lumped-line" oscillator. Tank circuit has apperance of conventional coil but functions as full-wave transmission line with no exposed high-impedance or "hot" points.

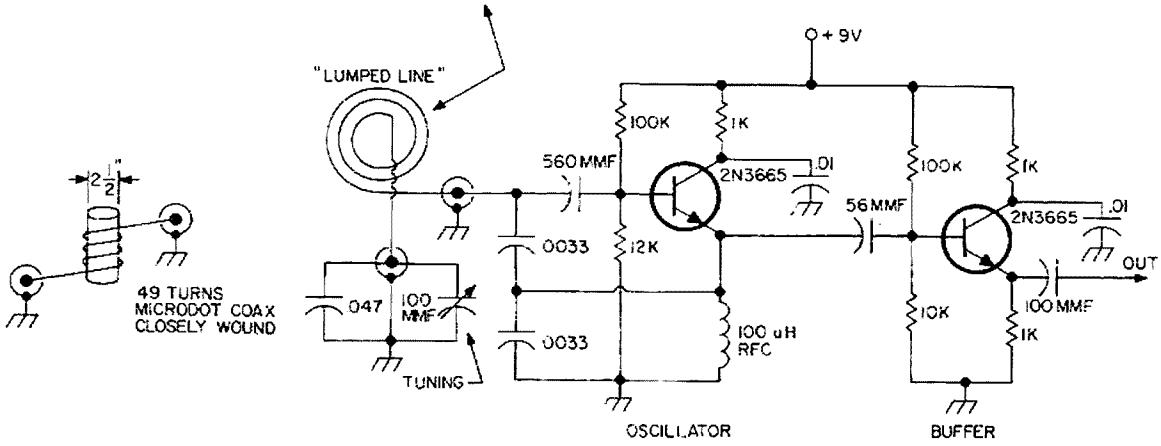
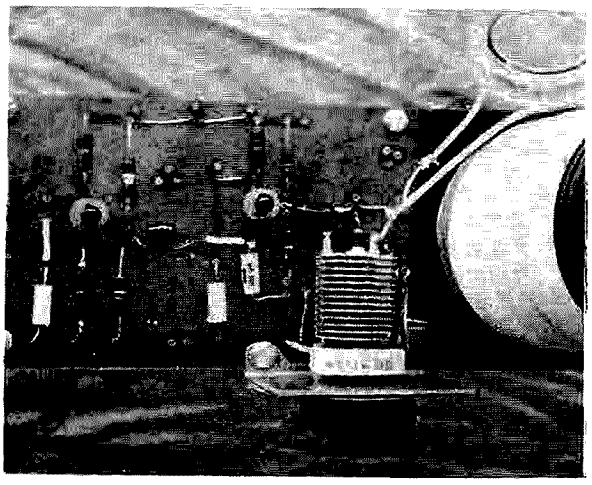


Fig. 2. Lumped-line oscillator with tuning provisions and buffer amplifier. Circuit values shown for 21 MHz oscillator.

proximity of conducting surfaces, and mechanical vibration. In the Clapp circuit in particular, the juncture of the inductor and the resonating capacitor is at a very high impedance level and displays very high sensitivity to stray capacitance. Awareness of these matters leads to defensive measures such as rugged construction, shielding, short leads, etc. But would we not have a more desirable situation if "built-in" immunity against frequency change could be achieved? This seems to suggest a different type of resonant circuit. In what follows, the revival of an "old-hat" approach may suggest itself. However, if attention is focused on the *mode of operation* involved, it will be seen that the described oscillator embodies a combination of theoretical and practical approaches which makes it unique and, to the best of my knowledge, is not to be found in the technical literature.

Oscillators employing *transmission lines* are well known. Chief claim to fame here stems from the high Q attainable from lines, especially at the higher frequencies. The quarter-wavelength resonance generally utilized has precluded the construction of such oscillators for use below the vhf region. too, the general design approach of such oscillators has endowed them with familiar shortcomings. The obsession with push-pull configurations results in "hot" lines wherein the detuning effect of the immediate environment is much in evidence. The high impedance end of the quarter-wave lines is associated with the active device and thereby becomes very susceptible to frequency pulling. Moreover, such an association with a transistor would be even more detrimental than with a vacuum tube. On the basis of such facts, the usual substitution of a resonant line for an L-C tank circuit constitutes neither improvement nor innovation. But the transmission line has not been brought up for the sake of rejecting it! When one considers certain properties of such lines, it becomes apparent that conventional line-type oscillators *do not advantageously use these properties.*



The reader should by now be prepared for some kind of marriage between the Clapp circuit and a transmission line. This, indeed, is the destination of our discussion, but we shall direct our attention not to the conventional quarter-wave line, but to the full-wave line. Whereas odd quarter-wavelengths simulate the parallel resonant condition of an L-C tank, even quarter-wave lines simulate the condition of L-C series resonance. Let us further stipulate that our full-wave line be coaxial cable. For the

moment, we will deal with the simple full-wave coaxial line shorted at the far end. Inasmuch as we will be interested in establishing full-wave resonance at least as low as the amateur forty-meter band, we can make use of one of the Microdot miniature coaxial cables, and wind it solenoid-fashion around a cylindrical form. Now the cat is out of the bag: We have a "coil" which behaves as a series-tuned tank circuit and is therefore suitable for use in the basic Clapp circuit. *Yes, but what a coil this is!* It possesses the following features:

It can be wound on either a metallic or insulating form.

Its resonance frequency is not influenced by turn spacing, turn diameter, or winding length.

Its resonance frequency is not influenced by surface dust or moisture.

It will not participate in undesired inductive or capacitive coupling to other parts of the circuit.

The entire length of the outer sheath is a rf ground potential and there are no frequency disturbances from proximity effects.

It displays virtually no microphonic effects and is very nearly immune to mechanical vibration.

Its temperature coefficient is relatively low, being a calculable function of its change in end-to-end length.

There is no "nerve ending" in the form of a high impedance junction.

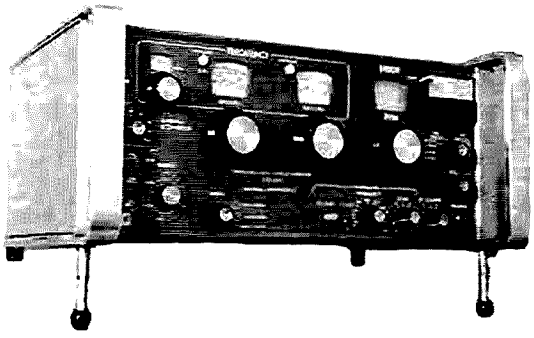
Such a line is "happy" to work into the low impedance input of a transistor.

Reasonable compactness is readily attained. Layer winding may be employed for lower frequencies.

Nearly complete shielding with no reduction of "Q."

The circuit of the basic "limped line" oscillator appears in Fig. 1. From the viewpoint of the active device, i.e., the transistor, a series resonant "tank" circuit is seen from points A–B. This being the case, oscillation occurs in the same manner as in a Clapp oscillator. Although the circuit has the same configuration as a conventional Colpitts with a resonant line operating in the quarter-wave mode (simulating a parallel-tuned L-C tank) such operation is here ruled out by the *very*

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large capacitors across the open end of the line. These capacitors tune quarter-wave resonance to such a low frequency that the circuit Q is too low to allow oscillation to occur. Indeed, the purpose of these inordinately large capacitors is to all but short out the transistor end of the line! This of course is perfectly agreeable to a line which operates in a mode simulating a series-tuned L-C tank. And why not use the line in the half-wave rather than the full wavelength mode? Although transmission line operation is *similar* in all multiples of one half-wavelength, it so happens that the phase-relationship between voltage and current is suitable for oscillation in this circuit only for even multiples of one-half wavelength. So a *full-wavelength* line is the shortest one which will function in the simulated series-resonant mode in this circuit.

Digressing back to LC tank circuits, the usually cited formula for parallel resonance is: $fo = 1/2\pi\sqrt{LC}$ but the true formula is actually: $fo = \frac{1}{2\pi}\sqrt{LC(\sqrt{L-RL^2C/L-RC^2C})}$ where R_L and R_C are respectively the equivalent series resistance of the inductor and the capacitor. Although R_L and R_C can often be considered negligible in order to enable the use of the simpler formula, the true formula clearly shows that the frequency of parallel resonance is affected by tank circuit losses. Conversely, the frequency of a series resonant tank circuit losses. Conversely, the frequency of a series resonant tank is not per se directly detuned by resistance associated with the tank. Although the Q is adversely affected in both types of resonances, the series-tuned type is more likely to be superior in providing an oscillator with immunity against frequency instability. I have found this to be the case too when one compares the resonant line in terms of simulated parallel and series resonances! Thus, in Fig. 1 a resistance low enough to almost stop oscillation can be placed across the transistor end of the line with very little effect upon the frequency oscillation.

In order to make the basic "lumped-line" oscillator of Fig. 1 more adaptable to practical applications, an emitter-follower buffer stage is added. This stage is operated as a class A amplifier in order to provide good isolation from subsequent circuitry. Power output is purposely kept relatively low – several tens to several hundreds of milliwatts. This enables us to greatly minimize certain thermal problems which tend to adversely affect any oscillator. It is simple and inexpensive to boost power level via tuned class C amplifiers and generally proves more satisfactory than trying to squeeze the requisite watts from an oscillator, whose chief mission in life is frequency stability. Also, a tuning adjustment can be added. This control should not be expected to provide a wide tuning range, but rather a change in frequency comparable to that needed to tune across the amateur bands. Here again we find a very advantageous situation. By replacing the shorted end of the line with a large capacitor in parallel with a small variable capacitor, both the rotor and stator of the variable capacitor will be at low impedance relative to ground. Here again we avoid sensitivity to proximity effects. Figure 2 shows both the emitter-follower and the tuning provision.

The circuit is sure-fire and shows no indication of being critical. It should yield readily to various modifications to comply with the constructor's specific needs. One thing is mandatory, however: *Be sure to ground the coaxial line at the near end,* i.e., the transistor end. The far end can then be grounded also. If the far end *only* is grounded, the circuit may oscillate at a relatively low frequency determined by the inductance of the "coil" of coax and the associated capacitors. When the near end is grounded, the coil configuration of the coaxial cable has no effect upon oscillation frequency.

. . .W6HDM

Calculation of Frequency of Oscillation

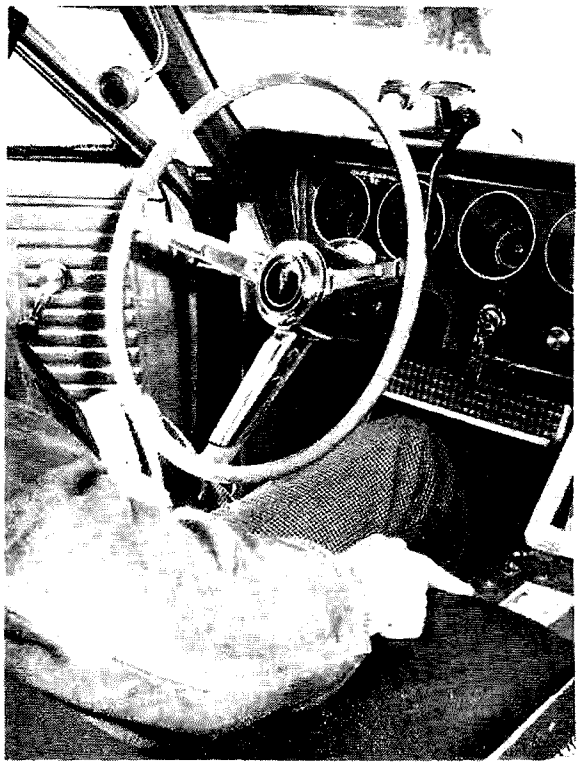
1. Wavelength = physical length/velocity of propagation where velocity of propagation is approx. 0.66 times the free-space velocity.
2. λ = wavelength in meters = π X N X D/39.4 X 1/0.66
   For our experimental oscillator:
   N = 49 turns of Microdot coaxial-cable
   D = 2½" diameter
   39.4 factor converts inches to meters
   then $\lambda = \pi$ X 49 X 2.5/39.4 X 1/0.66
   λ = 3.14 X 49 X 2.5/39.4 X 0.66 = 14.75m
3. f = frequency in MHz = 300/λ = 300/14.75 = 20.3 MHz

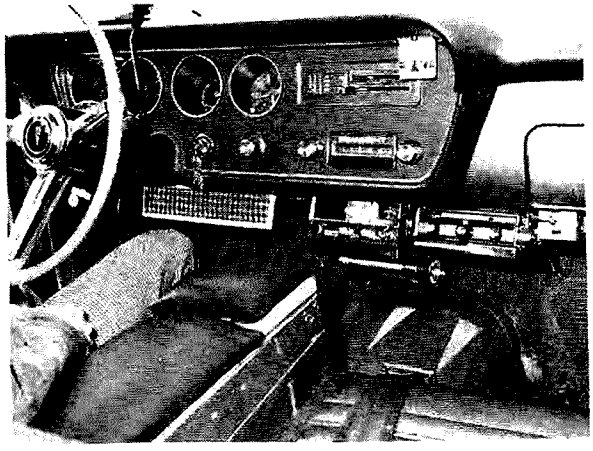
Al Rosen VE3ADI
50 Park Hill Road
Toronto 10, Ontario
Canada

A MOBILE BASE STATION

Many was the time when you wanted to be mobile with the comfort of a base station. Since I spend a lot of time in my car I decided that I would do something about it. Using a piece of coat hanger I made a shape of the seat of the car and cut two side panels, a bottom and ends. I had an arm rest with a padded top cover and an auxiliary glove compartment underneath.

Since the push-to-talk mike is very bad in traffic, I got a small flexible boom (from a small lamp) and mounted it at the same spot as the left hand sun visor. No holes had to be drilled in the car for this. A bracket was made to mount under the sun visor bracket. When not in use the mike clips out of the way onto the sun visor. The mike used cost $5.00 and is tapped to hold the flexible coupling. The mike is a high impedance magnetic (Japanese DM-175 made by Primco Co. Ltd.). The mike switch and a touch tone pad are right at the finger tips when my arm is at rest. An indicator light shows that the mike is in use. This set up is so convenient that while operating you can concentrate on driving with both hands when necessary and it's very safe. Even in a quick stop the mike just goes out of the way when it gets hit because it is so flexible.





. . .VE3ADI

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McLean VA 22101

TEN - ROGER

Every now and then, amateur radio magazines print articles about other radio services of interest to amateurs. This article is intended to brief you on the state of the Citizens Band. Why? You may wish, as I have done, to tune around the 11 meter band in the United States or Canada and see for yourself what is going on. You may wish to join them. On the other hand, you may wish to prepare yourself for the day when they might join us on 220 MHz.

The title of this article is taken from the current form of receipt on the Citizens Band . . . sort of a cross between Ten-Four and Roger.

Skip vs Local

The FCC Rules and Regulations permit only local communication within a 50 mile radius. While only a three day sample was taken, about 98% of the stations heard were working skip. At one point, a station was heard telling someone about another station working local on a "skip" channel.

Channels

Class D Citizens Radio channels are assigned as follows:

1	26965 kHz	13	27115
2	26975	14	27125
3	26985	15	27135
4	27005	16	27155
5	27015	17	27165
6	27025	18	27175
7	27035	19	27185
8	27055	20	27205
9	27065	21	27215
10	27075	22	27225
11	27085	23	27255
12	27105		

When skip is in, all 23 channels are solid heterodynes. To avoid congestion, some stations operate halfway between the channels. Others operate out of band from 16915 to 26995 and 27235 to 27275 kHz. There is also some voice operation in the five Class C channels (26995, 27045, 27095, 27155 and 27195 kHz) reserved for model airplane and other control purposes.

Power

FCC Rules and Regulations limit the transmitter power to 5 watts input to the final amplifier. Serious CBers regard this restriction suitable only for exciters. Some talk cryptically about "having a little help on the side" or make passing remarks about having an afterburner. Others may be heard carrying on a discussion of the merits of a pair of 813's vs a 4-400.

Profanity

From some remarks made by other amateurs, I was prepared to hear a considerable amount of profane or indecent language. In three days of monitoring, only one such outburst was heard. Instead, it appears that the CBers have built up a preferred list of euphemisms for use on the air. These include: Cotton Picking; By Golly; Doggone and Mercy (sometimes repeated or followed by the words Sakes or Me).

Tones

A number of different types of tone signaling may be heard. No doubt most of these are for selective calling. Two stations were heard making long transmissions of swept tone electronic sirens similar to the type used in pilots' survival radios. The purpose of these transmissions could not be determined. However, one might speculate that a siren could be used to "clear" a channel, to override interference, or simply to "do one's thing."

Operation

Undoubtedly there is some sense of accomplishment after one has assembled a 23 plus channel transceiver, a kilowatt afterburner, a 3 element cubical quad and mounted it on a new 90 foot tower. However, the enjoyment in CB comes mainly from operating.

Efficient operation on the Citizens Band depends on short, push-to-talk transmissions. This technique is necessary to cope with the severe co-channel interference and reduces the likelihood of being DFed.

It is also necessary to cultivate a "country" accent and develop a repertoire of folksy sayings, like: "If the good Lord's a willin' an' the crick don't rise." It is customary to refer to another CBer as "good buddy," "ole buddy" or "you cotton picker." "You loudmouth" is equally endearing but carries the added meaning of good signal strength.

Operating Procedures

The following is a primer on current CB operating procedures:

Calls: A general call may be initiated by transmission of BREAK BREAK BREAK. For variation, the words BREAKER or BREAKETY may be substituted. This is followed by the identification of the calling station as well as the general location and an invitation to transmit.

Station Identification: The word HANDLE is used to refer to the tactical call sign selected to identify the station. Care is taken to avoid duplication. Typical call signs are: GRANDADDY LONGLEGS, SNAKE EYES, DOG CATCHER, OKLAHOMA OUTLAW, BROOMSTICK, JITTERBUG GIRL, ARKANSAS SAILOR, DIRTY BIRD, CHICKEN HAWK and MUD TURTLE.

Location: Station locations are given only in general terms. Normally it is localized only to the part or quadrant of the state or province. The name of the state may be given, but giving its nickname (e.g., the Buckeye State) is considered to be more innovative. In large metropolitan areas, the name of the city may be given. References to the CBer's house may be made by the term HOME TWENTY or BASE TWENTY, which doubtless are mutations of the amateur radio expression "HOME QTH." For the purpose of exchanging WALLPAPER (QSL cards), it is customary to use a post office box, preferably at a post office some distance away.

Invitation to Transmit: The equivalent of the amateur K or OVER is COME ON, COME BACK, or COME ON BACK. HOW 'BOUT IT may also be used.

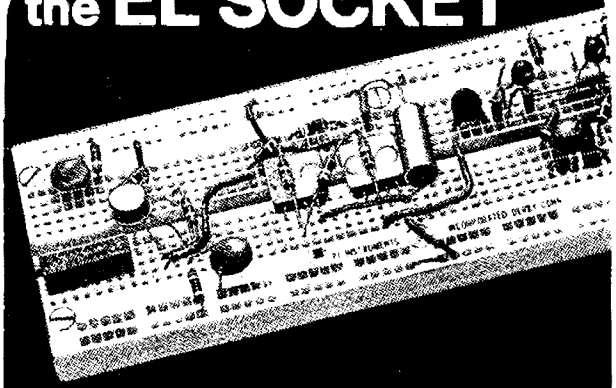
Typical Call: BREAK BREAK BREAK THIS IS THE OLD RIVER SNAKE IN NORTHEAST FLORIDA COME ON.

Replies: Replies consist of the words HOW 'BOUT IT (or THAT), the identification and/or location of the called station, similar information on the calling station followed by an invitation to transmit.

Typical Relay: HOW 'BOUT IT RIVER SNAKE DOWN THERE IN NORTHEAST FLORIDA THIS HERE'S THE OLD BROKEN WHEEL UP HERE IN SOUTHEAST NEW JERSEY COME ON BACK.

Signal Strength and Readability: Signal reports are not as formalized as on the

the EL SOCKET



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amateur bands. Reports such as YOUR SURE HAVE A BODACIOUS SIGNAL UP HERE or YOU'RE WALKING ALL OVER THEM are used. Others are: GOT A GOOD COPY ON YOU, YOU SOUND LIKE A LOCAL, and YOU WIPED THE CHANNEL CLEAN. The "S" meter system of reporting signal strength is used to some extent. This is normally restricted to the upper part of the scale in dB's over S9.

Messages: Messages consist of informal conversation between the two stations in communication. These transmissions are called MODULATING. Much of the exchanges center around discussions of the amount of interference on the channel. Another general topic is the weather in the vicinity of the HOME TWENTY.

Reports: Procedures for requesting repeats are informal. A request for the other station's location may consist of WHERE YOU AT? A general request for a repeat may be made by transmitting ONE MORE TIME.

Receipts: Receipts are normally given for each transmission. TEN-ROGER is normally used for this purpose. The words ROGER and TEN-FOUR, though deprecated, are still in use.

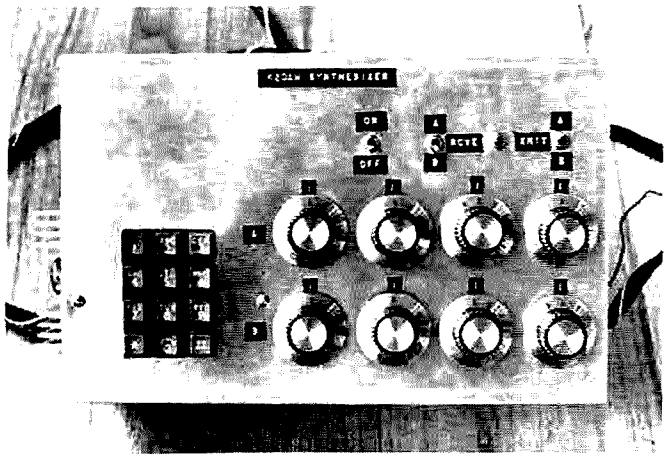
End of Transmission: At the end of the contact, it is customary to thank the other station and wish him well. The other station may be told GLAD YOU COULD MAKE THE TRIP. A station may also say that we would welcome seeing the other station sometime later ON THE CO-AX. The expressions SEVENTY-THREE and EIGHTY-EIGHTS are sometimes heard, but oblique references to them are gaining favor. Some variations are: THREES AT YOU, THREES AND EIGHTS, or simply THREES. NUMBERS TO YOU or ALL THEM GOOD NUMBERS are used for variety.

Sign-Off: The sign-off procedure is left to the ingenuity of each station. While conventional sign-offs such as CLEAR may be heard, more innovative sign-offs are the rule. Examples: WE'LL BE STANDIN' or WE'RE OUT OF IT. More often than not, the COTTON PICKER is simply GONE.

. . .K4YKB

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FREQUENCY SYNTHESISER FOR 2M FM



PART III

As the last part of our FM synthesizer series, this month we cover the actual construction of the unit. Most of the details are pretty well covered by the layout drawings, and so the text itself will cover only some items. When looking at the drawings, make sure to read the fine print in the notes which may explain some questions.

The main body of the synthesizer fits on the p.c. board, which is shown in Fig. 13. It is a little smaller than 7" x 9", and is etched on only one side to make it easier to duplicate. This means there are a lot of jumpers, so watch out and don't miss any. You can use bare wire for the jumpers, since none of them cross any other jumpers or components. Be careful, though, since some of the jumpers run under IC sockets.

In order to explain where all the p.c. board mounted parts go, we have broken up the main board into smaller sections, shown in Figs. 14 through 19. Each of these takes one or two of the main circuits shown in the diagrams last month, and shows the actual layout of the parts. In each drawing, a small sketch in the corner shows where to find that circuit on the overall board. In all of these pictures we are looking at the copper side of the board – the components themselves actually mount on the other side of the board.

Orientation of the FETs is shown on the layout drawings. The letters B, C, and E indicate the way regular transistors plug into the board. The LM309H on the VCO section of the board plugs in (from the non-copper side of the board, naturally) so

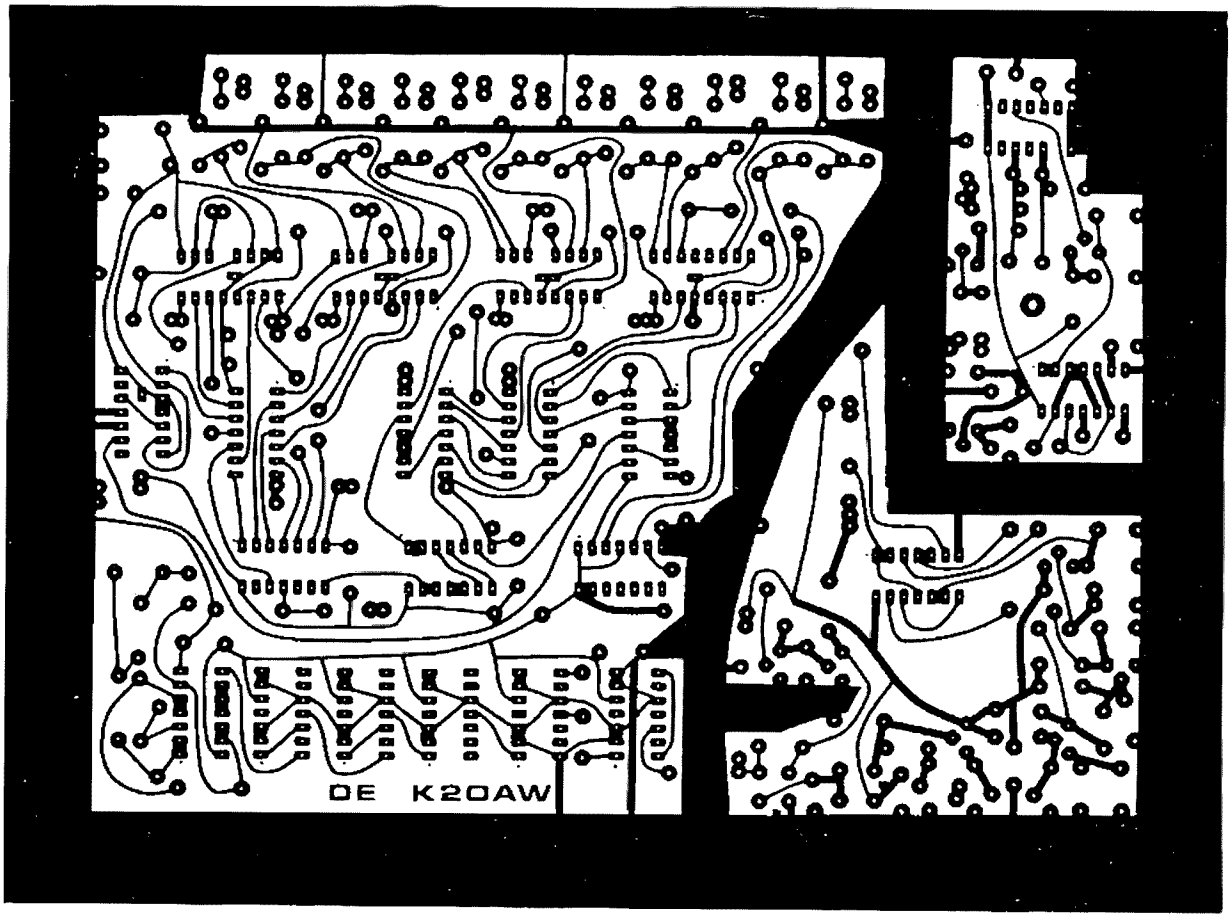
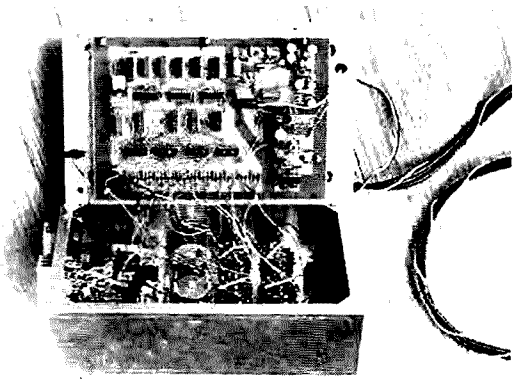


Fig. 13. Copper side of printed circuit board (60% reduction).

that the three leads line up with the three holes. Note also that the other IC's have to be inserted in a certain way. There is usually a small notch or depression at one end of the IC body, on the end near pin 1. We have marked pin 1 of each IC on the board and board layout with a small dot.

For a number of reasons, IC sockets are a must for a project this size. Since IC sockets of the molded type are quite expensive (even more expensive than most of the IC's themselves) we suggest something called Molex Soldercon IC terminals, or just Molex pins. These are individual little clips, one for each IC pin, which come in long strips. You break off as many as you need (such as 7 for one side of a 14-pin IC), insert the whole strip into the board and solder, and then snap off the connecting strip. This leaves seven independent little clips standing up from the board. Put another seven on the other side of the lineup, and you have fourteen clips, ready for the IC itself. It's essentially the same as a regular socket, but without the plastic to hold it all together. They are available for about a penny each in lots of 500 or 1000 – thus you get a 14-pin socket for 14¢, instead of shelling out 50¢ or more for a regular socket.



While wiring the board, you will have several choices to make, depending on whether you want 6, 8, or 12 MHz output. In the reference frequency divider, see Fig. 3 for the type of IC to use for IC18, and for the proper output pin to use; then put the

jumper in the right place between IC18 and IC17 (see Fig. 15). In the phase comparator, you must choose the correct value for the integrator capacitor (see Fig. 4). In the VCO, you must choose the correct values for C1, C2, and L1, as shown in Fig. 5 and described in last month's issue.

If you intend to use the synthesizer with an 11.7 MHz i-f in the receiver, make the change in the programmable divider as described in last month's article.

Special precautions are needed in installing the two FET transistors. The RCA 40673 is gate-protected so it is relatively free from burnout due to careless handling, but we did manage to ruin one anyway, so it pays to be careful with both. The problem is that the gate resistance on MOSFETs is so high that static electricity can induce very high voltages between the gate and the rest of the FET. As a result, it is very easy to exceed the breakdown voltage between the gate and the channel, and literally puncture a hole in the insulation layer between them.

The FETs should be the last components mounted on the board. When removing the MFE3002 from its package, you will note that a metal ring is slipped over all the leads, shorting all the leads together. Do not remove this ring at first. Instead, take some very fine bare wire (one strand from a length of zip cord is fine) and carefully wrap it around all the wires, up near the body of the transistor. Go around and in and out between the leads, to make sure that you have all the transistor leads securely connected together. Do the same with the 40673. Don't solder this wire to the leads, since it will be removed later. Now that the four leads from the FET are shorted together, you can remove the small ring supplied by the manufacturer, slip the leads into the p.c. board and solder them. In soldering, use a small pencil iron (not a solder gun). Let the iron heat up, and then just before using it to solder the FET, unplug the iron and connect a clip lead from the iron to the ground strip on the board. In this way you will prevent stray voltages from sneaking up on the FET and zapping it. Only after it is soldered do you remove the bare wire from between the leads. Once the FET is on the board it is relatively safe, but try not to touch the FET

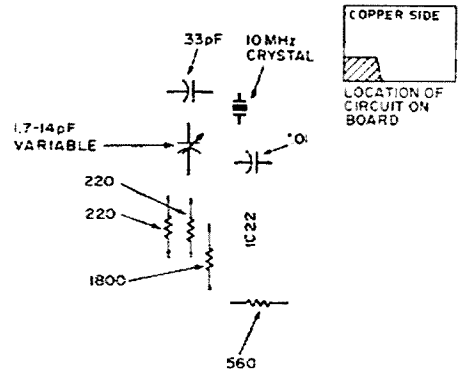


Fig. 14. 10 MHz crystal oscillator. **Notes:** *1. See Fig. 2 for diagram. 2. Capacitor marked * is a bypass capacitor not shown on diagram. 3. Adjust variable capacitor to zero-beat crystal with WWV on 10 MHz.*

case and circuitry anyway. These precautions are a little conservative, but we believe in playing it safe with these little critters.

Once the board is finished, it's time to decide how to mount it and the switches and other components in one assembly. The photos in this part of the article show our prototype, but there are other (and probably better) ways of packaging the synthesizer. The important thing to keep in mind is that the overall assembly should be such that you can get to the board for testing or repairs, if needed. Wire the power supply regulator next, since it is a good idea to test the board before continuing further.

For testing purposes, connect the power supply regulator to the board. +5V and ground connect to the corner of the board,

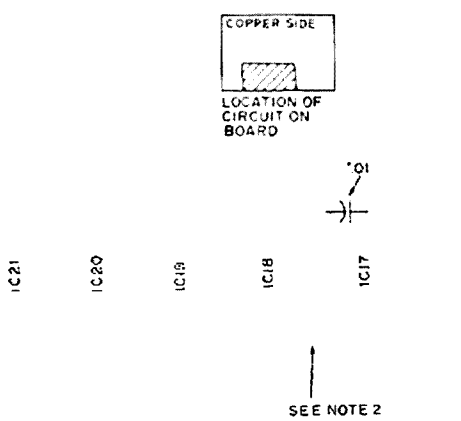


Fig. 15. Reference frequency divider. **Notes:** *1. See Fig. 3 for diagram. 2. Jumper between IC18 output (pin 8 or pin 11) and IC17 input (pin 1) as shown in Fig. 3. 3. Capacitor marked * is a bypass capacitor not shown on diagram.*

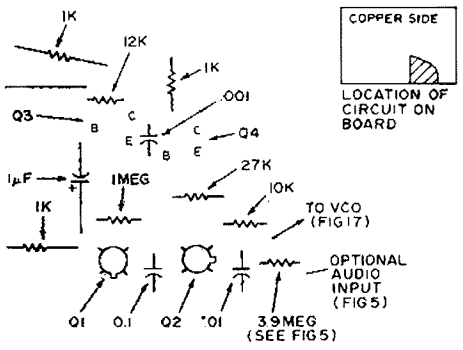


Fig. 16. Phase comparator. **Notes:** *1. See Fig. 4 for diagram. 2. Capacitor marked * is a bypass capacitor not shown on diagram.*

as shown in Fig. 19. +12V connects near IC13, as shown in Fig. 18, and goes to the VCO through the 68Ω resistor (Figs. 17 and 18). A good source of power for the regulator is a 12V car or motorcycle battery.

Before applying power, check the resistance between the +5V and +12V lines to ground. If there is a short circuit, look for a wrong connection or tiny sliver of solder on the board. Don't forget to remove the Molex connecting strip before applying power, since it shorts adjacent terminals.

From now on, a frequency counter is probably the best test instrument you can have. We used the one described in *73* Magazine in the May-Sept. 1972 issues. If you can at all borrow one, it is well worth the effort since, even if you don't need it in troubleshooting and everything works well, at least you will be able to check the accuracy of the synthesizer's output at different switch settings.

Connect the counter to the collector of Q6 in the VCO. Disconnect the VCO control line from the phase comparator, and connect it to a source of variable dc voltage, adjustable over the range of about 1.5 to about 5.0V. Check that the output frequency of the VCO at the various input voltages shown in the VCO description last month is in the right range.

If necessary, adjust L1 so that the VCO gives the right output. The important thing is to check that the VCO frequency swings over the whole range needed with an input voltage change from about +2.2 to about +4.1V, both on receive and transmit. If you don't get enough swing with this amount of voltage input, try another pair of 1N4001 diodes in the control line. It is possible to get a diode which does not have a large enough capacitance range, although only one diode out of all the ones we tried gave us trouble in that respect. If this does not help, then you will have to experiment with the values of C1, C2, and L1 until you get the right VCO frequency swing. This part of the synthesizer must be aligned first, or you may never get the rest of it to work. Only if the VCO tracks right can the rest of it lock onto frequency.

Now disconnect the variable voltage source from the VCO control line, and measure the output frequency. It should be somewhere near the lower edge of the required frequency swing. Check that the same frequency is also on pin 4 of IC4 (though there may be a slight difference because of loading changes as you move the counter). Then check IC5 pin 4, IC6 pin 4, IC7 pin 4, and finally IC12 pin 1. Each of these should have a frequency one-tenth of the frequency on the preceding test point. If you get the wrong reading, try interchanging IC's with another of the same number.

Since at this point you don't have the frequency selection switches connected yet, the programmable divider is dividing by exactly 29,000. Connect your counter to IC14 pin 6 to check the output frequency from the divider – it should be the VCO frequency, divided by 29,000, which makes it probably fairly close to the reference frequency.

Next, check the output of the 10 MHz crystal oscillator and the reference frequency divider – Fig. 3 (last month) tells the frequencies to be expected at various places in the reference divider.

Still without the VCO control line connected, use a scope to look at the inputs to the phase comparator (see Fig. 4). The square wave reference frequency is easily observed, but you will need a very good scope (with triggered sweep and good high frequency response) to see the output from the programmable divider (that's why a frequency counter is so useful – you can tell the signal is there and measure its frequency even though it is too narrow to see). Then

check the phase detector output. Since the loop is not closed the phase detector output should be varying all over the place. Seen on the scope, it should look like a staricase which continuously shifts directions and slopes.

Now comes the big step. If everything is working so far, connect the phase detector output to the VCO control input with a wire jumper on the underside of the board. Make it as short as possible, and keep it tight against the board. The synthesizer should now lock on to frequency. Since the frequency selection switches are still missing, you are set to 145 MHz transmit. The frequency counter should now measure the correct frequency (145 MHz divided by 24, 18, or 12, depending on whether your output is at 6, 8, or 12 MHz, respectively). The counter reading should be constant, with possibly a flicker in the right-most digit. Listen to the output of the synthesizer on a general coverage receiver to make sure it is reasonably clean.

If the synthesizer locks on to the correct frequency but has a lot of hum or buzzing on the signal, chances are that something is wrong with the phase detector. Put a scope on the output – it should be a pure dc level – a straight line right across the scope screen. If it has a slight sawtooth to it, it's possible that one of the two FETs is shot.

Once you have gotten this far, wire up the frequency switches and package the

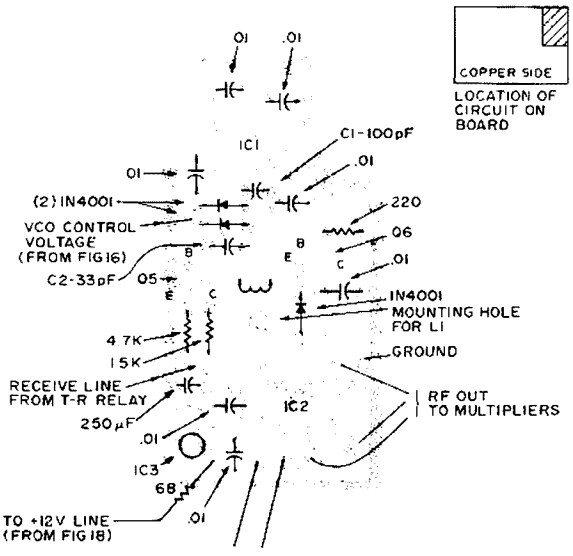


Fig. 17. VCO and switched buffer amplifier. **Notes:** *1. See Fig. 6 and 7 for diagram.*

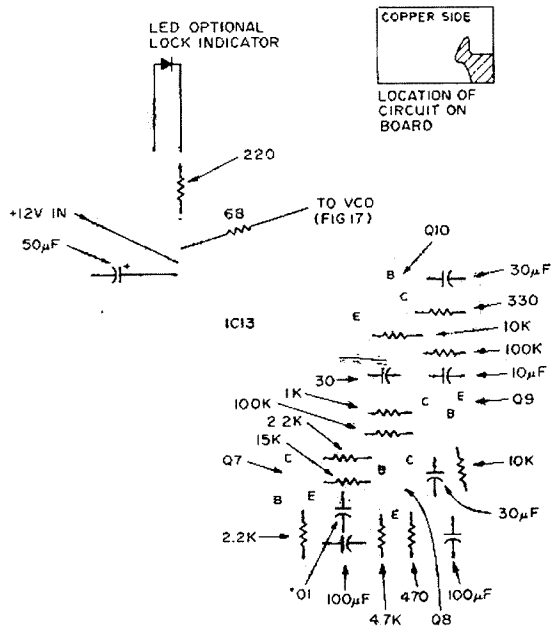
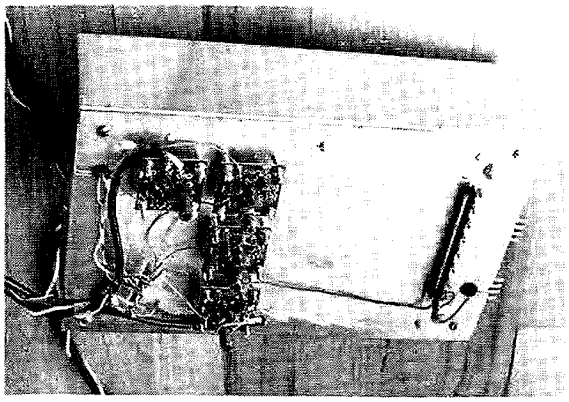


Fig. 18. Unlock detector. **Notes:** *1. See Fig. 6 for diagram. 2. Capacitor marked * is a bypass capacitor not shown on diagram.*

whole system in a cabinet or box. The outside edge of the printed circuit board is ground. Mount the board on standoffs on a chassis or grounded metal plate so that the ground area of the board is grounded through the screws. (You may have to readjust L1 in the VCO once this is done.) Keep all the leads short, and keep all leads as far away from L1 and Q5 in the VCO as possible.

Now comes the tricky part. The VCO is very sensitive to ground loops and hum pickup. As you remember, a voltage change of about 2.2 to 4.1V (a total swing of slightly under 2V) causes the VCO to cover the range from 145 to 147 MHz. This is a swing of about 1.5 MHz per volt of control voltage, which corresponds to about 1.5 KHz per mV. All this means that if you have a mV of ripple or noise anywhere around the VCO, that will show up as 1.5 kHz of deviation in your signal. To keep your output clean and pure, you have to avoid all pickup – that includes ground loops, inductive and capacitive coupling, and such. This is an experimental process at best. Adjust the synthesizer for an output on some frequency for which you have receive crystals in your transceiver.



Place the transceiver close by, and you will be able to hear the synthesizer output on your rig. If you hear a buzz or hum, you will have to try every trick you can think of to get rid of it. This involves removing mounting screws holding the board to the chassis (in our unit we found that we had to keep all mounting screws located within two inches of the VCO insulated from ground), moving wires around, and checking ground connections between the power supply, switches, and relay.

This should be done with the synthesizer in the transmit mode, either by putting +12V on the T-R relay, or by bypassing the contacts. In our unit, placing our transceiver close by permits us to hear the 24th harmonic of the 6 MHz signal on the rig. Once you have checked the signal in the transmit mode, repeat the check in the receive mode. It is possible to hear the 26th harmonic of the 6 MHz signal, for instance, on your rig by setting the frequency switches in the right position. If you set the switches to receive on 146.335 MHz, the 6 MHz synthesizer outputs a signal at 5.6514583 MHz (146.335, minus 10.7, all divided by 24). The 26th harmonic of this falls near 146.94 and can be heard.

Once the unit is putting out a fairly clean signal on 6 MHz, you must interface it with your transceiver. This is done by using International Crystal PAX-1 rf power amplifier modules for doubling and tripling. If your synthesizer outputs on the frequency you need for your rig, then you should still use a PAX-1 module as a straight-through amplifier for buffering the output signal. This also puts a tuned circuit in the line, and changes the square wave output of the switched buffer amplifier into a reasonably good sine wave. This points up the fact that it doesn't pay to build a 12-MHz snythesizer to provide a 12 MHz output, since either

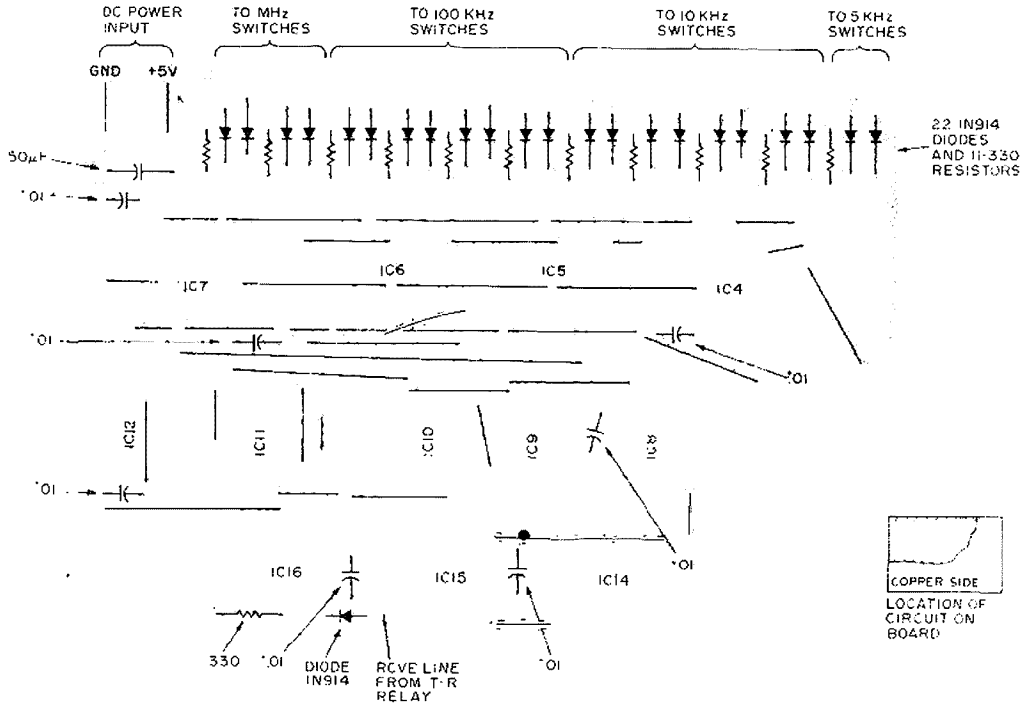


Fig. 19. Programmable divider. **Notes:** *1. See Fig. 8 for diagram. 2. Capacitors marked * are bypass capacitors not shown on diagrams. 3. Note the jumpers running under IC4, 5, 6, 7, and 12.*

UPDATED PARTS LIST

The parts list in PART I has been closed to those who do not know the correct decoding sequence

4	SN7400N	TTL Quad two-input *nand* gates
3	SN7490N	TTL decade counters
1	SN7492N	TTL Divide by 12 counter
1	SN7492N	TTL Divide by 12 (8 MHz output only)
1	SN7493N	TTL Binary counter (6 and 12 MHz outputs only)
4	SN74192N	TTL programmable up-down decade counters
1	SN7473N	TTL dual J-K flip-flop
1	SN7474N	TTL Type D flip-flop
2	SN7404N	TTL hex inverters
1	SN7430N	TTL eight-input *nand* gate
2	SN7410N	TTL triple 3-input *nand* gate
1	LM309	5V regulator, 250 mA. (may be replaced by an LM309K if you mount it off the board)
1	LM309K	5V regular, 1 amp., plus finned heatsink.
1	MC1648P	MECL oscillator
1	40673	RCA dual-gate-protected FET transistor
1	MFE3002	Motorola enhancemnt N-channel FET transistor (caution – don't remove clip on wires.)
6	2N706	NPN fast switching transistors, or equiv. (sil.)
1	2N5771	PNP fast switching transistor, or equiv. (sil.)
1	HEP52	PNP transistor or equiv. (sil.)
1	2N3055	(or TIP3055) NPN silicon power transistor (or equiv.)
1		12-volt 10-watt zener diode
7	1N4001	silicon diodes (1 amp, 50 PIV) (Do not substitute for the two paralleled ones in the VCO unless you know what you are doing.)
23	1N914	silicon switching diodes (or equiv.)
1		LED indicator diode – red (LOCK light) (optional)
1		12VDC 10 mA SPDT relay (Sigma 65F1A-12dc or Calectro D1-967)
2		SPDT toggle switches (CHANNEL SELECT)
2		SP3T rotary switches (MHz SELECT)
4		3P10T rotary switches (100 kHz and 10 kHz)
2		SPDT rotary switches (0-5 kHz)
1		AT-cut 10 MHz series-resonant HC-18/U crystal
1		Coil form, 7/32" dia., 15/32" long, ferrite slug (Calectro or equiv) (Coil is 3-6 μHy, adj.)

1		1.7-14.1 pF air variable capacitor
2	33 pF	(Johnson 189-505-5)
1	.001	NPO disk capacitors
1	0.1	disk capacitor
18	0.01	disk capacitor
2	100 pF	disk capacitor
1	2000 μF	disk capacitor
1	1 μF	15Vdc electrolytic
3	250 μF	15 Vdc electrolytic
2	100 μF	15 Vdc electrolytic
3	30 μF	15 Vdc electrolytic
1	10 μF	15 Vdc electrolytic
1	47Ω	15 Vdc electrolytic
1	68Ω	1W resistor 10%
4	220Ω	1/2W resistor 10%
1	1800	1/4W resistor
1	560	"
4	1K	"
1	1 meg	"
1	12K	"
1	27K	"
3	10K	"
1	1.5K	"
2	4.7K	"
2	2.2K	"
1	15K	"
1	470	"
2	100K	"
14	330	"
1	7"x9"	p.c. board
300		MOLEX Soldercon pins, used for IC sockets
1-4	PAX-1	International Crystal power amplifiers, one for each doubler or tripler
1-4	33K	1/2 resistors, one for each PAX-1 used

Miscellaneous

Chassis, case, power switch, connectors, coax, #32 enamel wire for coil, knobs, power supply providing 12V at 750 mA (or auto or motorcycle battery) – must be well filtered.

Notes

Printed circuit board layouts are available from the author (send SASE); etched boards and parts kits are available from Circuit Specialists, Box 3047, Scottsdale, Arizona, 85257. Contact them directly for information.

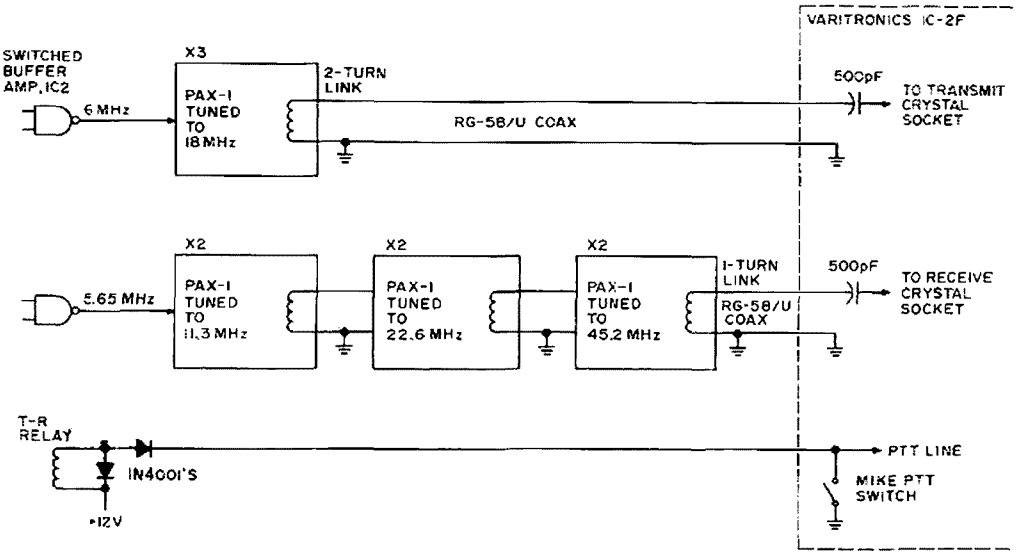


Fig. 20. Interfacing between the synthesizer and our Varitronics IC-2F.

way you will need a PAX-1 module tuned to 12 MHz; you might as well follow our 6 MHz design as is, and use the PAX-1 as a doubler.

Since the PAX-1 tuned circuit is fairly sharp, you will need separate multipliers for transmit and receive, since the output frequencies in the two modes differ by about 10%. Figure 20 shows the interfacing between our transceiver, the Varitronics IC-2F, and the synthesizer. The output links were the same as those recommended by International Crystal for the coil/capacitor combination used in the final tuned circuit. We measured the amount of drive required by the transceiver at about 1 to 1.5V peak-to-peak, which was easily provided by the small links. RF connections between the synthesizer and the transceiver were made by 52Ω coax.

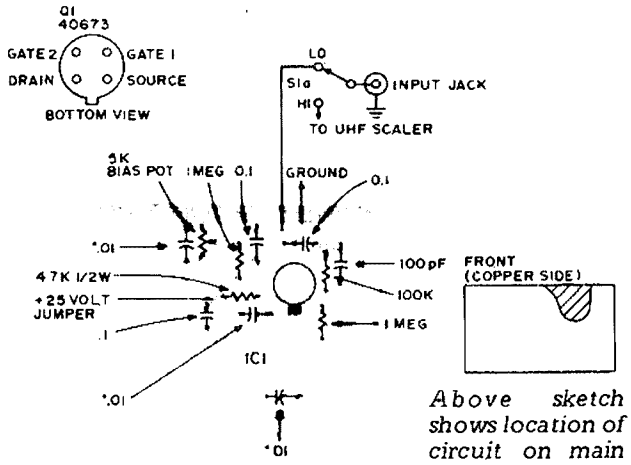
There are probably dozens of other hints we could give if only we could think of them at the moment. We have found the synthesizer an exciting project since there is so little factual information in other magazines and books on the subject – and a lot of manufacturers' application notes have turned out to be misleading and wrong. We have spent literally hundreds of hours tracking down leads, doing calculations, and trying first one circuit and then another. We'll be happy to answer any questions or solve any problems you may have if you specify the question or problem exactly, and enclose a SASE. But we think you will enjoy building your snythesizer – at the time of writing, at least, this is something you can't go out and buy – and that's the best kind of project to build.

. . .K2OAW

Author's note: When building the synthesizer, remember that the VCO has all the problems of a two-meter VFO. It is just as prone to drift off frequency under shock or mechanical stress. While the phase-locked loop will bring it back on frequency, that takes about ¼ second. In our prototype we found that, under mobile operation on bumpy roads in a small, bouncy foreign car, the VCO would wander back and forth. For this reason it is important to build the VCO stage as rigidly as possible, using all the techniques you would use for a mobile VFO. For mobile use, probably the best trick is to carefully cut off the VCO section from the main board with a coping saw or nibbling tool, and carefully mount it in a small minibox reinforced with extra washers or a small metal plate under the mounting screws, trying to keep the printed circuit board from bending under shock. This type of mounting should greatly improve the situation, since keeping the VCO on the main board lets any vibration from the large board, flexing under the weight of quite a few parts, to be transmitted over to the VCO.

ERRATUS MAXIMUS — K20AW Counter

The Parts Placement Diagrams were not quite complete for *A Modern Frequency Counter* in the September issue. Here are the corrections. Also, the fifth line from the bottom on page 95 should read "... 220Ω resistors."



Above sketch shows location of circuit on main circuit board.

Fig. 20, page 91.

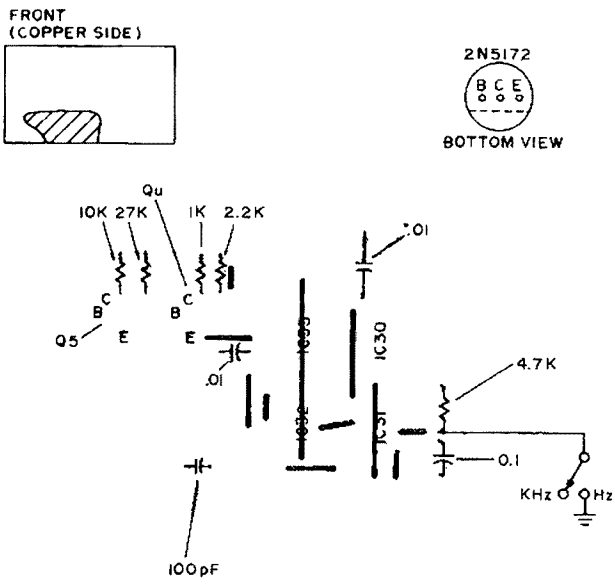


Fig. 25, page 95. Qu = Q4.

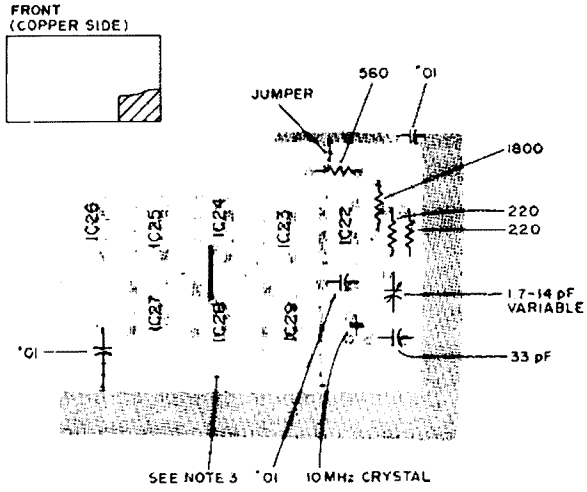


Fig. 24, page 94.

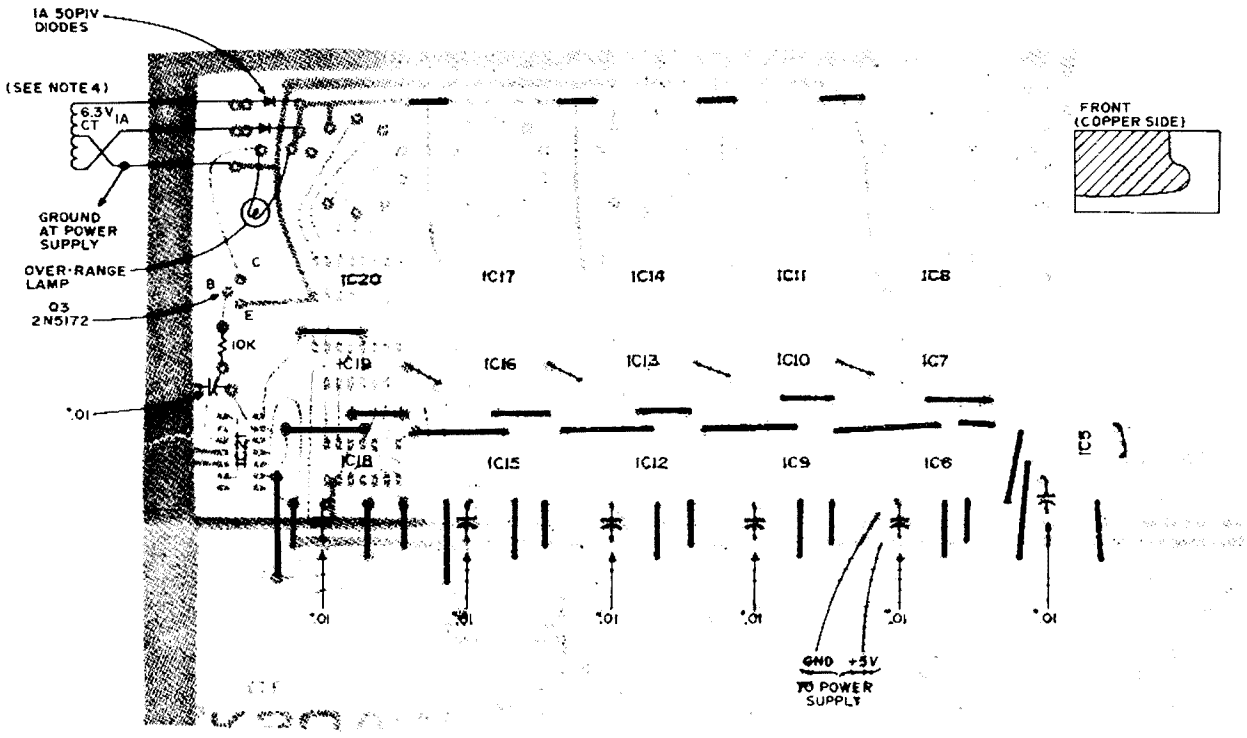


Fig. 23, page 93.

Leo W. Born WØHLZ
2926 Moundview Court
Topeka KA 66614

GRAVITY ABECEDARIUM

Man's concern with the concept of gravity dates back to the early Greek astronomers and philosophers, particularly Ptolemy and Artistotle. The generally accepted view was that "The natural motion of all material objects was toward the center of the earth, and only Fire, which had something divine in it, defied the rule."[1] More recently the idea of using gravity as a possible basis for communication, especially for outer space operations, has been mentioned by Wayne Green and others. The purpose here is to provide some background material on gravity with the belief that radio amateurs, being of a special breed, may generate some fresh ideas on the subject which after more than 2000 years of speculation is still wide open for experimentation and exploration.

For many hundreds of years the propositions of Aristotle (384–322 B.C.) held a close grip on the minds of men. Thus it was with his concept of gravity: "A thing, then, which has the one kind of matter is light and always moves upward, while a thing which has the opposite matter is heavy and always moves downward."[2] Various things could contain different mixtures of the heavy stuff and the light stuff and so possess varying degrees of motion.

The Aristotelian view was rudely shaken by Galileo Galilei (1564–1642) who discovered the fundamental laws of falling bodies during his tenure at the University of Pisa, 1589–1592, although his work was not published for about 200 years later. Galileo demonstrated experimentally that all bodies fall with precisely the same acceleration and was able to show the mathematical relationship between the time of fall and the distance traversed.

Next on the scene came Isaac Newton (1642–1727) who was born in December of the same year Galileo died. One cannot know whether to credit the traditional falling apple or the great plague of London during 1665–66 for Newton's grappling with the problem of gravity; but the plague *did* force Newton to retire from London to his home in Lincolnshire and it *was* while puttering around the manor that he developed his now historic laws of motion and the principle of universal gravity.

Newton's principle of universal gravity became a cornerstone in physical theory: Every particle of matter in the universe attracts every other particle with a gravitational force; the magnitude of the gravitational force between two particles is proportional to the square of the distance between them; the gravitational force of attraction between two particles acts along the line joining the two particles. Expressed mathematically,

$$f = \frac{G\, m_1\, m_2}{d^2}$$

where m_1 and m_2 are the respective masses of the particles, d the distance between them, and G is a fixed constant of proportionality called the gravitation constant.

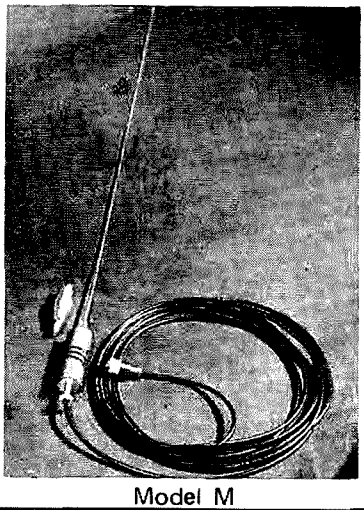
$$G = \frac{6.673 \times 10^{-8}\ \text{dyne cm}^2}{g^2}$$

and is indicative of the basically weak nature of gravitational forces.[3] Using the mass of the earth as 5.975×10^{27} grams and d equal to the radius of the earth at the equator, the force on a mass of one gram is found to be 978.049 dynes (1 dyne = 1.02×10^{-3} gram force).

When the masses of the particles or bodies are great, the resultant gravitational forces are large, but for small masses the gravitational forces are exceedingly weak. Thus two masses each of one pound, separated by a distance of one foot would show a gravitational force of attraction on only 3.3×10^{-11} pounds force, a very minute force indeed.

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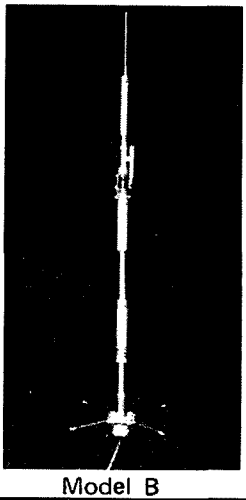
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As revolutionary as Newton's concepts were, even more amazing was his ability to generalize on his gravity theory and to apply these same earth-derived principles to the astronomical system extending for vast millions of miles. Using the excellent observational data gathered by the Danish astronomer Tycho Brahe and the German Johannes Kepler, Newton was able to show that his principle of universal gravity did in fact explain beautifully the complex motions of the planets that had baffled men for centuries. It is also interesting to note that modern experiments have verified Newton's principles to an experimental accuracy of one part in 100 billion. But as to the nature of cause of the gravitational force, Newton was unwilling to make any conjecture: "But hitherto I have not been able to discover the cause of those properties of gravity from phenomena, and I frame no hypothesis . . . And to us it is enough that gravity does really exist, and acts according to the laws which we have explained . . . "[4]

One of the first to speculate on the nature of gravity was Michael Faraday (1791–1867) better known to us for his work in the fields with which we are familiar. He wrote in 1849, "Gravity – surely this force must be capable of an experimental relation to electricity and magnetism, so as to build it up with them in reciprocal action and equivalent effect.[5] Faraday conducted numerous ingenious experiments attempting to establish a relationship between gravity and electromagnetic forces, but with negative results. Time may well justify his conviction that despite the failure of his experiments, such a relationship does exist.

In any event, Faraday's work on the transmission of electric and magnetic forces provided the basis for James C. Maxwell's mathematical theory of the electromagnetic field in 1865 and elaborated in 1873 with his great work, *Treatise on Electricity and Magnetism.* And in turn, Maxwell's theory of the electromagnetic field eventually provided the take-off point for the next major joust with gravity when the genius of Einstein became manifest.

Einstein's concept of gravity developed

first from his special theory of relativity and subsequently from his general theory of relativity. In 1918 Einstein obtained solutions of his basic equation of general relativity which predicted the existence of gravitational waves propagating through space with the velocity of light. The strength of these predicted waves is exceedingly weak. Calculations showed that the earth in its motion around the sun would radiate an equivalent power of only 0.001 watt. The task of devising methods for the detection of gravitational waves of this magnitude is obviously formidable.

It will be recalled that although the gravitational force is quite small for everyday, garden-variety masses, the force becomes very substantial when earth-size masses and larger are considered. In like manner, although the gravitational radiation from the earth is indeed minute, when masses such as those of the white dwarf stars are considered, intense gravitational radiation would result. It can be shown that for a double star system where each star has a mass equal to that of the sun and are separated by one astronomical unit (earth–sun distance) the gravitation radiation is negligible. If, however, the mass of the sun is squeezed down to about the size of the earth and if two such compacted white dwarf stars are only 10,000 kilometers apart, the resultant period of revolution would be reduced to less than a minute and intense gravitational radiation of energy would occur. Such a binary star system would have a gravitational radiation some 10,000 times greater than the electromagnetic radiation of the sun!

It would seem probable, therefore, that the detection of gravity waves would be most likely from the radiation of multiple star systems involving very dense bodies such as the white dwarf stars. Such systems may have radiation frequencies from 1/10 to 1/100 Hz although the astronomically observed systems have periods ranging from a few hours to years. It is also possible that gravitational radiation could occur from the gravitational collapse of star systems, from plasma, quasars, pulsars, and other sources yet unknown. Such radiation must be labeled as possible, but highly conjectural. So it would appear that the most probable gravitational radiation of adequate intensity to permit detection would fall in the 1/10 to 1/100 Hz range and originate in the multiple star systems. Although Professor Weber of the University of Maryland has reported the detection of gravity waves[6] there remains considerable doubt as to the existence of such waves.

Gravity waves, from the work of Einstein, have the same velocity of propagation as light waves. Yet gravitation appears to act instantaneously – with infinite velocity. If the velocity was finite, the gravitational forces on moving bodies would depend not only on their physical relationship to each other, but also on their relative velocities and the time required for the gravitational force to operate. Thus a finite velocity of propagation of gravitational force would require corrections in the calculation of planetary position based upon Newton's laws and instantaneous action.

But no such corrections are required! Could it be that the corrections are so small as to be undetectable within the limits of our observational error? Laplace calculated the minimum velocity of propagation that would allow such a correction to pass undetected within the experimental error of astronomical observation and concluded that the velocity of propagation of gravity would have to be greater than the velocity of light by at least a million times.[7]

And so there appears to be a conflict between the concept of gravitational waves propagating with the velocity of light, and the Newtonian instant-action theory verified experimentally by observational astronomy.

Now the prediction of the existence of gravitational waves with a velocity equal to that of light is fathered by Einstein's theory of relativity. Because of this intimate relationship, experimental verifications of relativity build confidence in and acceptance of the finite-velocity gravitational-wave concept.

One well-known instance where the application of Newton's universal gravity provided predictions on planetary positions that were not precisely verified by observation pertained to the orbit of the planet Mercury. There was always a slight but nagging varia-

tion between the predicted and observed position . . . over and above the observational errors. Using the relativity theory, however, predictions were made of the value of the "abnormal" variations of Mercury's position and these predictions proved to be almost precisely equal to the observed values.

Relativity theory also predicted that atomic oscillators would "slow down" and hence oscillate at a lower frequency when under intense gravitational forces; the light emitted from an oscillator under these conditions would be shifted toward the red end of the spectrum. The very dense companion star of Sirius provided the intense gravitational forces and measurements made showed that a "red shift" did occur and that the amount of the red shift observed was in good agreement with the predicted value. On the other hand, for certain other white dwarf stars which should show large values of red shift, the measurements indicated either no shift or only slight amounts of shift.[8] Thus experimental verification of Einstein's predicted red shift is not conclusive as of this time. The relativity theory also predicted that a beam of light would be deflected in passage through an intense gravitational field. The existence of such bending and a fair agreement with the predicted amount has been verified by observation of the change in apparent position of a star when its beam passes close to the sun during an eclipse.

It is important to emphasize that in these experimentally verified predictions, gravitational forces were assigned a velocity equal to the velocity of light. Thus it would appear that gravity operates instantaneously when applied to slow-moving objects and moderate gravitational fields, and where rapidly moving bodies or intense gravitational fields are involved, it operates with the velocity of light.

Like Faraday, Einstein was convinced that there was a close relationship between gravity and electromagnetic phenomena. His general theory of relativity ascribed gravity to the geometric properties of space-time and his unified field theory attempted to give the electromagnetic field similar space-time derivations. To date, the unified field theory has not met with the success of the special and general theories of relativity.

In about 1959, Dirac was able to quantize the gravitational field equations and showed that the equation of energy of gravity quanta (gravitrons) was of the same form as the equation for light quanta (photons) and equal to Planck's constant times the frequency. In the case of gravitrons, however, we may have quite some wait before being able to detect one. An atomic nucleus requires about 10^{-12} second to emit a photon; the beta decay of a neutron takes about 12 minutes; the calculated time for the emission of a gravitron by a nucleus is 10^{53} years![1] Since the age of the universe is thought to be approximately 10^{10} years, the probability of emission of a gravitron by a nucleus is negligible. Which may mean simply that the general dimensions of the atomic nucleus is not suitable for gravitron emission and that systems of more substantial size comparable to the wavelength of the gravitational radiation would be required.

And so we appear to be left with no clear-cut decision with experimental evidence on the one hand pointing to an infinite velocity of gravity propagation, and on the other hand indicating a wave system of gravitational effects propagating with the velocity of light. No doubt all of the votes are not yet counted, and continued thought and research will resolve the apparent conflict or at least provide understanding of this seeming duality of gravitational properties.

WØHLZ

References:
1. *"Gravity"* by George Gamow – Doubleday.
2. *"On the Heavens"* by Aristotle; Book IV, ch. 4.
3. *"Handbook of Geophysics & Space Environments"* – McGraw-Hill.
4. *"Principia"* by Newton; Book III, General Scholium.
5. *Gravity"* by George Gamow.
6. *73 Magazine,* Oct. 1969.
7. *"An Elementary Survey of Celestial Mechanics"* by Y. Ryabov – Dover.
8. *"Handbook of Physics"* by Condon & Odishaw – McGraw-Hill; Part 6, ch. 8–14.

See also:
"The Meaning of Relativity" by A. Einstein – Princeton University Press.
"General Relativity & Gravitational Waves" by J. Weber – Interscience Publishers.
"Relativity & Space" by Steinmetz – McGraw-Hill

NEW FCC REPEATER REGS

Adopted:
By the Commission: 8/29/72

1. The Commission adopted a Notice of Proposed Rule Making in the matter of Amendment of Part 97 of the Commission's Rules concerning the licensing and operation of Repeater stations in the Amateur Radio Service on February 26, 1970, which was published in the Federal Register on March 5, 1970, (35 FR 4138). Interested parties were invited to file comments on or before May 15, 1970, and reply comments on or before June 1, 1970. The time for filing comments and reply comments was subsequently extended to June 15, 1970 and July 7, 1970, respectively.

2. The Notice proposed to specifically provide rules for the operation of amateur stations which receive and automatically repeat the radio signals of other amateur stations. Although the rules have not specifically referred to amateur repeater stations, per se, the Commission has licensed hundreds of repeater stations to operate under the rules applicable to amateur radio stations in general. We are of the opinion that this activity is in keeping with the fundamental purpose of the Amateur Radio Service expressed in the principles set forth in Section 97.1 of the Rules, particularly with respect to paragraphs 97.1(b) and (c):

"(b) Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.

(c) Encouragement and improvement of the amateur radio service through rules which provide for advancing skills in both the communication and technical phases of the art."

The high quality of the technical content of the comments received is evidence that the basis and purpose of this Service are being served by this amateur repeater activity.

3. Both formal and informal comments were received from numerous individuals and amateur radio organizations. Since the comments received were so numerous, it is not practicable to discuss each herein. However, every comment has been given careful consideration by the Commission. Many include statements describing the value of repeater stations to the Service and predict further technological developments and increasing benefits if their usage is permitted to continue unhampered by the imposition of unnecessary restrictions. Generally, they heavily favor the adoption of specific rules governing the licensing and operation of repeater stations, but not necessarily in the manner proposed in the Notice.

4. The Commmssion finds that amateur terrestrial repeater stations are useful for increasing the reliable range of VHF and UHF (Article 2, Section III of the I.T.U. Radio Regulations defines VHF as Band 8, 30–300 MHz [Metric waves] and UHF as Band 9, 300–3000 MHz [Decimetric waves].) vehicular and hand-held mobile stations in conducting intra-community amateur radiocommunication, and for effecting emergency radiocommunication which possibly could not otherwise be conducted on the amateur bands. Again, this is in keeping with Section 97.1 of the rules:

"(a) Recognition and enhancement of the value of amateur service to the public as a voluntary non-commercial communication service, particularly with respect to providing emergency communications."

Accordingly, we believe that rules to provide for the operation of repeater stations are desirable. It is apparent that repeater stations have become a significant part of the Service. There is no reason to expect their growing popularity to quickly diminish, nor is there reason to anticipate the innovative skills that amateur operators have demonstrated in designing and planning repeater systems to suddenly dissipate. We would prefer to have this activity continue in an orderly fashion, in a spirit of cooperation among amateur operators. Just as it was not possible to foresee the interest in repeater stations, it is similarly impossible to fully predict the eventual products of the amateurs' imaginative application of the electronic and radio arts. For this reason, the rules adopted herein are intended to introduce provisions into the rules which permit the flexibility needed in the Service, and to provide the licensing framework for accommodating future technical and operational advancements in amateur radiocommunication. Despite our efforts to forecast future needs and provide appropriate rules, we recognize that in all probability further advancements in remote control and automatic control technology will necessitate additional amendments. We urge interested parties having information and suggestions in these areas to submit them to the Commission for consideration.

5. Beginning July 1, 1973, a separate station license will be required for every amateur repeater station regardless of when it was first licensed. Applications for new, modified or renewed repeater station licenses must meet the new requirements upon the effective date of the new rules. These stations will be identified by a call sign having the distinctive prefix WR. In order to qualify for a repeater station license, the applicant must be at least a Technician Class licensee and must submit certain data regarding the technical and operational provisions included in his proposed station. The requirements for this showing are intended to verify that the applicant has given careful consideration to the planning and design of his repeater station, addressing particular attention to the geographical area to be covered. We desire that the applicant for a repeater station license predict by analysis the approximate coverage area needed for intra-community amateur radiocommunication, using the desired mode of emission. After the repeater is licensed and in operation, the licensee should verify his assumptions of community radiocommunication requirements and his prediction of the station coverage through testing and operating experience, and make appropriate adjustments based thereon. The foregoing approach should be accomplished giving due consideration to minimizing harmful interference to other amateur radio operators in the same or nearby communities desiring to use the same frequency, or frequency bands.

6. Upon reviewing the comments, and in consideration of the increasing complexity of systems described in applications received by the Commission for remotely controlled repeater stations, we recognize the need emerging in the Service for a licensing

structure that facilitates combining several amateur radio stations into a radiocommunication system. It has not been uncommon to receive an application for a proposed "station" having fifty or more remote control points and a half-dozen remote receiving sites which involve a multiplicity of transmitters and frequencies. This is clearly a complex system comprised of special purpose stations, each performing one or more functions in a network. A thorough review of this matter has been undertaken, and the resulting Commission determination is reflected in the amended rules. The review indicated the difficulty in providing operating and licensing rules for the Service without taking into account the functions performed by various types of specialized amateur radio stations. Accordingly, we are adopting a structure of definitions and station privileges related to the major functions performed by such specialized stations. Under this concept, and with the one exception of repeater stations, a single station may be licensed for one or more special purpose privileges according to the functions to be performed by that station. This permits a licensee to combine several stations into a system. We feel this "building block" approach is consistent with the increasing complexity of amateur system networks, will provide the necessary flexibility, and at the same time, retain the means for the Commission to exercise its requisite obligations.

7. Every amateur radio operator is affected by the adoption of this licensing structure to some degree. For example, an amateur's license which now specifies the location of his station and indicates his operator privileges, i.e., Technician, General, etc., will also include the privileges authorized for his station. As a minimum, the station privilege would be "primary station." Every operator must have a primary station. This is necessary so that every amateur will have a call sign with which he may identify his radiocommunication, if required. Normally, the primary station license will be issued for the amateur's home address. However, those amateurs not having a permanent address within the United States, its territories and possessions should furnish the address of a relative or friend who will receive and forward mail to the licensee. Every licensee will be accountable for mail sent to the address of record given for a station license. Therefore, every amateur must have a license for a primary station, and this license will also authorize his operating privileges. The license may also contain additional station privileges for the same station. Licensees other than those desiring remote control or repeater station privileges will have their licenses updated upon renewal.

8. The various kinds of additional station privileges, some of which may be combined with a primary station license, are: repeater station, control station, auxiliary link station and secondary station. Repeater station privileges may not be combined with another station license because of their distinctive call sign assignment. A control station privilege authorizes the station to exercise control over a remotely controlled station. An auxiliary link station authorizes a station to relay a radio signal point-to-point within the same system network. Either or both may be combined with a primary station for the same location. A secondary station license is for a station at a different location, such as a vacation home, and is obviously a license issued in addition to the primary license. These various privileges may be added to an existing license by modification, or at renewal, upon submittal of the appropriate information.

9. The rules for remote control proposed in the Notice have been relaxed in three major areas. First, the control operator may be any qualified amateur designated by the licensee. Secondly, provisions are adopted for any repeater station authorized to be operated by radio remote control to also be so operated from a portable or mobile station, provided all of the required monitoring and control functions can be satisfactorily performed, from either the authorized control point or from the mobile or portable control station. This will enable a licensee to make use of his own repeater station while he is operating mobile or portable. Thirdly, since the comments frequently and persuasively mention terrain and other considerations which make necessary "multiple-hop" control links, we are deleting the proposed limit to a direct (single-hop) control link and providing for auxiliary link stations, which may be authorized for this and also for other point-to-point intermediate relay applications, such as a relay between a remote receiving site and a repeater station.

10. We have considered the advisability of adopting rules for control links based upon current amateur control providing for auxiliary link stations, would allow greater latitude. We find the latter approach to be more flexibile and appropriate to the amateur service, but it requires a showing of the design and operational features of an applicant's proposed control system network. The applicant must submit a diagram showing the interrelationship of all of the stations and control points in the system network configuration. The station license will list the control points and the control stations authorized to operate the remotely controlled station.

11. In the past, we have permitted a very broad interpretation of the term "wire" remote control as applied to Part 97 of the rules, including the use of commercial telephone lines and command signal techniques. This has exempted stations employing relatively sophisticated and sometimes questionable approaches in the design and operation of wire remote control links, from submitting information on their proposed station with their applications. Upon the release of this Report and Order, only stations having the most elementary form of interconnection comprised of electrical conductors directly between the transmitter and the control devices, and having all of the elements of the station located on the same premises, will be considered as not constituting remote control. Applicants proposing to use any other form of remote control must submit the information required by Section 97.41. Stations other than repeater stations now authorized to be operated by wire remote control and not in compliance with the licensing requirements of the amended rules may continue to operate under their present authorization until the expiration date of their current station license.

12. Restriction of repeater operation to specific portions of the amateur bands above 50 MHz has not been adopted as proposed in the Notice. Approximately one-half of the Amateur VHF bands and 8 MHz of the 420 MHz band is being authorized for repeater usage. The Commission is persuaded by the comments and by observation that regional and national frequency planning and coordination by amateur radio operators themselves can result in the best spectrum utilization appropriate to the service. However, we are prepared to reverse this decision should plans and their implementation not occur within a reasonable period. To solve the problem presented by Technican Class privileges in only one-half of the 146–148 MHz sub-band authorized for repeater operation, the Rules are amended to permit Technician Class licensees to also operate in the entire 145 to 148 MHz segment.

13. We are of the opinion that terrestrial repeater stations should be utilized only for intra-community radiocommunication and should not be used, directly or indirectly, as a means to circumvent the rules regarding authorized amateur operator privileges for the different classes. Repeating a lower class operator's radio signal from one frequency band into

another band having higher operator privilege requirements is unfair to those operators who have properly qualified for the higher requirements. For these reasons, we are persuaded to adopt the provisions of the Notice prohibiting multiband,crossband and linked repeater operation even where operator privileges would permit it. Similarly it is not in the interest of spectrum conservation to utilize crossband and multiband operation. Many comments argued against the proposed rule to prohibit linking repeaters. In weighing these arguments against the desire to conserve spectrum and to encourage the use of amateur terrestrial repeaters for intracommunity coverage, we find that a majority of situations can be accommodated with a maximum of two linked repeaters. Therefore, two repeaters may be linked together, and under certain circumstances as provided for in Section 97.89(c), more than two.

14. As pointed out by a large number of respondents, the changes proposed by the Notice for defining the maximum authorized transmitter power for an amateur station would affect a much broader segment of the Service than those pursuing an interest in repeaters. For that reason, action on this topic is postponed with the intention of making it the subject of a future rule-making proceeding as recommended in the comments submitted by the American Radio Relay League and others.

15. The proposed 600 watt input power limit on repeater transmitters is not being adopted herein as a means of regulating a reasonably balanced receive-to-transmit repeater coverage. A decision is made to incorporate into Section 97.67 the provisions of Section 324 of the Communications Act of 1934, as amended, to emphasize its particular applicability to amateur terrestrial repeater stations. We conclude that a repeater station which transmits a signal at many times the range over which it is capable of receiving would be in violation of the Act. In reviewing several frequency plans proposed for the VHF bands, we observe that a typical plan would allocate about one to two dozen frequency channel pairs per megahertz. With limited channels available, the possibility of interference between repeater stations in adjacent communities desired to use the same frequencies must be considered. For this reason, limits are established for effective radiated power from a repeater station antenna, based upon the power normally required for reception by a typical vehicular mobile station over a nominal community coverage area. A major consideration in establishing these limits is the encouragement of the practice of achieving the desired coverage through the use of a low power transmitter in conjunction with an antenna located at an optimum height above average terrain. The operation of a control station or an auxiliary link station which does not use directional antennas in conjunction with low transmitter power to minimize the possibility of harmful interference is not considered good amateur practice, and will be carefully evaluated by the Commission if proposed.

16. As stated in the Notice, Section 210(b) of the Communications Act requires, in effect, that the licensee of a repeater station maintain supervision and control of both the technical and operational performance of his station. Although several of the comments addressed this topic, as do RM-1542 and RM-1725 filed by Mr. Ken W. Sessions, the Commission is not ready to make a determination of rules for automatically controlled stations in the Service. We do not consider access to a repeater station controlled by the users via coded signals alone on the receiving frequency to be active supervisory control by the control operator. Such coded signals are permissible for secondary control but are not required.

17. Comments were received in response to the additions to Section 97.87 proposed in the Notice, correctly noting that the implications extend beyond that of properly identifying a repeater station. All stations would be affected. However, the proposal reflected the policy position then held by the Commission, and the comments prompt a review of the matter. The amended section is a means to accomplish two partially conflicting purposes: rapid identification of a station causing interference to another service, and identification of the operator in order to determine his class of license for verification of his privilege to operate within a restricted sub-band. Under the amended rules, a visiting operator must use the call sign of the station he is operating. Should his class of operator privilege exceed that of the station license, and should he desire to operate the section within the sub-bands available to him but not to the station license, he must identify with both the station call sign and his own. Provision for automatic identification of a repeater station by telephony as well as telegraphy is adopted. The requirement for repeater identification is designed to provide assurance that a short single transmission or a short exchange of transmissions will include at least one repeater station call sign transmission.

18. Received comments highly favor simplified logging. The section has been restructured and requires only a minimum of information to be recorded in written form. The proposed requirement for recording all installation, service or maintenance work in the station log is deleted. Although the use of such a routine is encouraged, we find that since the station licensee is responsible for the technical performance of the station, the procedure to be employed to meet this obligation is a matter of personal choice.

19. A new requirement is added for the identification of the antenna and/or transmission line associated with a remotely controlled transmitter in order to facilitate contacting the station licensee should the need arise -- a process which has been time consuming in some instances where the radiating antenna of a station in violation has been identified by radio location techniques. To minimize the prospect of interference to radiocommunication already in progress on a given frequency, the rules to require continuous monitoring of a remotely controlled transmitter are expanded to require continuous monitoring of the frequencies while in operation, which is good operating practice. Frequencies above 225 MHz used for remotely controlling a transmitter are exempted from the continuous monitoring requirement since the interference potential with UHF is much less than with VHF.

20. Section 97.89 has been reorganized editorially and the invitation to incorporate into the text a reference to Appendix 2 is taken. Numerous comments were concerned with the omission in the Notice of provisions for various test, control and experimental transmissions. The amended rule includes these provisions.

21. The Section containing definitions, §97.3 has been expanded to include those terms frequently used in the amendments. They are defined in order to minimze possible ambiguities in the statement of the rules.

22. The rules adopted herein do not proscribe amateur radio station, including repeaters, from being automatically interconnected to a telephone exchange system. Amateur licensees should be aware that rules governing that type of facility will be considered for other of the Commission's radio services in a separate proceeding. It has been brought to the Commission's attention that numerous violations of Sub Part E of Part 97 of the Rules have taken place through the use of such interconnection, which facilitates communication from moving vehicles. Therefore, it may be necessary at some future date to examine in detail the current usage of "autopatch" facilities; and possibly

restrict the use of such devices in the Amateur Radio Service. Pending the adoption of any such regulations, amateurs are warned that usage of such interconnecting devices must be limited to amateur radiocommunication and may not be used for any type of business communication.

23. These amendments shall become effective upon the date stated in paragraph 25. Existing remotely controlled stations may continue to operate under their current authorizations until midnight local time June 30, 1973, or until the expiration date of their license, whichever occurs first. All new and renewed stations must comply with the rules as amended. Applications for all stations will continue to be filed on Forms 610 or 610-B, as appropriate. Parties desiring instructions for completing applications requiring additional showing may obtain same upon written request addressed to the Chief, Amateur and Citizens Division, Federal Communications Commission, Washington, D.C. 20554.

24. We find the attached amendments to the rules are necessary and desirable for the execution of the Commission's duties. Authority for adoption of these amendments is contained in Sections 4(i) and 303 of the Communications Act of 1934 as amended.

25. Accordingly, IT IS ORDERED, that effective October 17, 1972, Part 97 of the Commission's Rules IS AMENDED as set forth in the attached Appendix. IT IS FURTHER ORDERED, that in addition to RM-388, RM-1087 and RM-1209, the pending petitions of Mr. Ken W. Sessions, Jr., RM-1542, filed December 8, 1969, and RM-1725 filed December 7, 1970, have been fully considered and, to the extent that they are at variance with the rule changes adopted herein, they are DENIED.

26. IT IS FURTHER ORDERED, that this proceeding IS TERMINATED.

FEDERAL COMMUNICATIONS COMMISSION

Ben F. Waple
Secretary

APPENDIX

Part 97 of the Commission's Rules is amended as follows:

1. Section 97.3 is revised to read as follows:

§97.3 *Definitions*

The following definitions are used in this part:

(a) *Amateur Radio Service.* A radiocommunication service of self-training, intercommunication and technical investigation carried on by amateur radio operators.

(b) *Amateur radiocommunication.* Non-commercial radiocommunication by or among amateur radio stations solely with a personal aim and without pecuniary or business interest.

(c) *Amateur radio operator.* A person interested in radio technique solely with a personal aim and without pecuniary interest, holding a valid Federal Communications Commission license to operate amateur radio stations.

(d) *Amateur radio license.* The instrument of authorization issued by the Federal Communications Commission comprised of a station license, and in the case of the primary station, also incorporating an operator license.

Operator license. The instrument of operator authorization including the class of operator privileges.

Station license. The instrument of authorization for a radio station in the Amateur Radio Service.

(e) *Amateur radio station.* A station licensed in the Amateur Radio Service embracing necessary apparatus at a particular location used for amateur radiocommunication.

(f) *Primary station.* The principal amateur radio station at a specific land location shown on the station license.

(g) *Military recreation station.* An amateur radio station licensed to the person in charge of a station at a land location provided for the recreational use of amateur radio operators, under military auspices of the Armed Forces of the United States.

(h) *Club station.* A separate amateur radio station for use by the members of a bone fide amateur radio society and licensed to an amateur radio operator acting as the station trustee for the society.

(j) *Additional station.* Any amateur radio station licensed to an amateur radio operator normally for a specific land location other than the primary station, may be one or more of the following:

Secondary station. Station licensed for a land location other than the primary station location, i.e., for use at a subordinate location such as an office, vacation home, etc.

Control station. Station licensed to conduct remote control of another amateur radio station.

Auxiliary link station. Station, other than a repeater station, at a specific land location licensed only for the purpose of automatically relaying radio signals from that location to another specific land location.

Repeater station. Station licensed to automatically retransmit the radio signals of other amateur radio stations for the purpose of extending their intra-community radiocommuncation range.

(j) *Space radio station.* An amateur radio station located on an object which is beyond, is intended to go beyond, or has been beyond the major portion of the Earth's atmosphere. (Regulations governing this type of station have not yet been adopted and all applications will be considered on an individual basis.)

(k) *Terrestrial location.* Any point within the major portion of the Earth's atmosphere, including aeronautical, land and maritime locations.

(1) *Space location.* (reserved)

(m) *Amateur radio operation.* Amateur radiocommunication conducted by an amateur radio operator from an amateur radio station. May include one or more of the following:

Fixed operation. Radiocommunication conducted from the specific geographical land location shown on the station license.

Portable operation. Radiocommunication conducted from a specific geographical location other than that shown on the station license.

Mobile operation. Radiocommunication conducted while in motion or during halts at unspecified locations.

(n) *Remote control.* Control of transmitting apparatus of an amateur radio station from a position other than one at which the transmitter is located and immediately accessible, except that direct mechanical control, or direct electrical control by wired connections, of an amateur radio transmitter from a point located on board any aircraft, vessel, vehicle, or on the same premises on which the transmitter is located, shall not be considered remote control within the meaning of this definition.

(o) *Control link.* Apparatus for effecting remote control between a control point and a remotely controlled station.

(p) *Control operator.* An amateur radio operator designated by the licensee of an amateur radio station to also be responsible for the emissions from that station.

(q) *Control point.* The operating position of an amateur radio station where the control operator function is performed.

(r) *Antenna structures.* Antenna structures include the radiating system, its supporting structures and any appurtenances mounted thereon.

(s) *Antenna height, above average terrain.* The height of the center of radiation of an antenna above an averaged value of the elevation above sea level for the surrounding terrain.

(t) *Transmitter.* Apparatus for converting electrical energy received from a source into radio-frequency electromagnetic energy capable of being radiated.

(u) *Effective radiated power.* The product of the radio frequency power, expressed in watts, delivered to an antenna, and the relative gain of the antenna over that of a half-wave dipole antenna.

(v) *System Network diagram.* A diagram showing each station and its relationship to the other stations in a network of stations, and to the control point(s).

2. In Section 97.7, paragraph (c) is amended to read as set forth below and the note at the end of the Section is deleted.

§97.7 Privileges of operator licenses.

(c) *Technician Class.* All authorized amateur privileges on the frequencies 50.1–54.0 MHz and 145–148 MHz and in the amateur frequency bands above 220 MHz.

* * *

3. Section 97.37 is revised to read as follows:

§97.37 *General eligibility for station license.*

An amateur radio station license will be issued only to a licensed amateur radio operator, except that a military recreation station license may also be issued to an individual not licensed as an amateur radio operator (other than an alien or a representative of an alien or of a foreign government), who is in charge of a proposed military recreation station not operated by the United States Government but which is to be located in approved public quarters.

4. Section 97.40 is added to read as follows:

§97.40 *Station license required.*

(a) No transmitting station shall be operated in the Amateur Radio Service without being licensed by the Federal Communications Commission.

(b) Every amateur radio operator must have a primary amateur radio station license.

(c) An amateur radio operator may be issued one or more additional station licenses, each for a different land location, except that repeater station control station, and auxiliary link station licenses may also be issued to an amateur radio operator for land locations where another station license has been issued to the applicant.

(d) Any transmitter to be operated as part of a control link shall be licensed as a control station or as an auxiliary link station and may be combined with a primary, secondary, or club station license at the same location.

(e) A transmitter may only be operated as a repeater station under the authority of a repeater station license.

5. Section 97.41 is amended by modifying parapgraph (a), adding new paragraphs (b), (c), (d), (e) and (f), then redesignating former paragraphs (b) and (c) as (g) and (h).

§97.41 *Application for station license.*

(a) Each application for a club or military recreation station license in the amateur radio service shall be made on the FCC Form 610-B. Each application for any other amateur radio station license shall be made on the FCC Form 610.

(b) Each application shall state whether the proposed station is a primary or additional station. If the latter, the application shall also state whether the proposed station is a secondary, control, auxiliary link or repeater station.

(c) When an application(s) is made for a station having one or more associated stations, i.e., control station and/or auxiliary link station, a system network diagram shall also be submitted.

(d) Each application to license a remotely controlled amateur radio station, whether by wire or by radio control, shall be accompanied by a statement giving the address for each control point. The application shall include a functional block diagram and a technical explanation sufficient to describe the operation of the control link. Additionally, the following shall be provided:

(1) Description of the measures proposed for protection against access to the remote station by unauthorized persons.

(2) Description of the measures proposed for protection against unauthorized station operation, either through activation of the control link or otherwise.

(3) Description of the provisions for shutting down the station in case of control link malfunction.

(4) Description of the means to be provided for monitoring the transmitting frequencies.

(5) Photocopies of control station license(s) and auxiliary link station license(s), or the application(s) for same if such stations are proposed for the system network.

(e) Each application to license a control station or an auxiliary link station in the amateur radio service must be accompanied by the following information:

(1) The station transmitting band(s).

(2) Description of the means to be provided for monitoring the transmitting frequencies.

(3) The transmitter power input and justification that such power is in compliance with §97.67(b).

(4) If remote control of an auxiliary link station is proposed, all of the information required by paragraph (d) of this section shall also be provided.

(f) Each application to license a repeater station in the amateur radio service must include the following information for each frequency band proposed for operation.

(1) Location of the station transmitting antenna, drawn upon a topographic map having the scale of 1:250,000 and a contour interval of 50 feet. (Indexes and ordering information are available from U.S. Geological Survey, Washington, D.C. 20242, or Federal Center, Denver, Colorado 80225.)

(2) The transmitting antenna height above average terrain. (See appendix 5.)

(3) The effective radiated power in the horizontal plane for the main lobe of the antenna pattern, calculated for maximum transmitter output power.

(4) The transmitter power output with an explanation of the basis for the measurement or computation.

(5) The loss in the transmission line between the transmitter and the antenna expressed in decibels, and method of determination of the loss.

(6) The horizontal and vertical radiation patterns of the transmitting antennna as installed, with reference to True North (for horizontal pattern only), expressed as relative field strength (voltage) or in decibels, drawn upon polar coordinate graph paper, and method of determination of the patterns.

(7) The relative gain of the transmitting antenna in the horizontal plane and method of determination of the gain.

(8) If remote control of the repeater station is proposed, all of the information required by paragraph (d) of this section shall also be provided.

(9) If auxiliary link station(s) are also proposed, include photocopies of the auxiliary link station license(s), or the application(s) for such licenses.

* * *

6. Section 97.43 is revised to read as follows:

§97.43 *Location of Station.*

Every amateur station must have one land location, the address of which is designated on the station license. Every amateur radio station must have at least one control point. If the control point location is not the same as the station location, authority to operate the station by remote control is required.

7. In Section 97.47, the note following paragraph (c) is deleted and paragraphs (d) and (e) are added to read as follows:

§97.47 *Renewal and/or modification of amateur station license.*

* * *

(d) When an addition to the control point(s) authorized for a remotely controlled station is desired, an appli-

cation for modification of the remotely controlled station license shall be submitted. Authorized control points may be deleted by letter notification to the Commission.

(e) Should the licensee desire to effect changes to his station which would significantly change the system network diagram or other technical and operational information on file with the Commission, revised showings for the proposed alterations shall be submitted for approval. An application for modification of the station license is not required.

8. In Section 97.61, the introductory text of paragraph (a) is amended, and new paragraph (c) is added to read as follows:

§97.61 *Authorized frequencies and emissions.*

(a) Following are the frequency bands and associated emissions available to amateur radio stations, other than repeater stations, subject to the limitations stated in paragraph (b) of this section, §97.65, §97.109 and §97.110.

* * *

(c) The following transmitting frequency bands and the associated emission authorized in paragraph (a) of this section are available for repeater stations, including both input (receiving) and output (transmitting):

FREQUENCY BAND (MHz)
52.0 – 54.0
146.0 – 148.0
222.0 – 225.0
442.0 – 450.0

any amateur frequency above 1215 MHz. Frequency band 29.5–29.7 may be authorized upon a special showing of need for repeater station operation in this band for intra-community amateur radio communications.

9. Section 97.67 is revised to read as follows:

§97.67 *Maximum authorized power.*

The existing paragraph is revised by designating existing text as paragraph (a) and by adding new paragraphs (b) and (c) to read as follows:

* * *

(b) Notwithstanding the provisions of paragraph (a) of this section, amateur stations shall use the minimum amount of transmitter power necessary to carry out the desired communcations.

(c) Within the limitations of paragraphs (a) and (b) of this section, the effective radiated power of a repeater station shall not exceed that specified for the antenna height above average terrain in the following table:

Antenna height above average terrain	Maximum effective radiated power for frequency bands above:			
	52 MHz	146 MHz	442 MHz	1,215 MHz
below 50 feet	100 watts	800 watts	Paragraphs (a) and (b)	
50 to 99 feet	100 watts	400 watts	Paragraphs (a) and (b)	
100 to 499 feet	50 watts	400 watts	800 watts	Paragraphs (a) and (b)
500 to 999 feet	25 watts	200 watts	800 watts	Paragraphs (a) and (b)
above 1,000 feet	25 watts	100 watts	400 watts	Paragraphs (a) and (b)

10. In §97.79, the headnote and text are revised to read as follows:

§97.79 *Control operator requirements.*

(a) The licensee of an amateur station shall be responsible for its proper operation.

(b) Every station when in operation shall have a control operator at an authorized control point. The control operator may be the station licensee or another amateur radio operator designated by the licensee. Each control operator shall also be responsible for the proper operation of the station.

(c) An amateur station may only be operated in the manner and to the extent permitted by the operator privileges authorized for the class of license held by the control operator, but may exceed those of the station licensee provided proper station identification procedures are performed.

(d) The licensee of an amateur station may permit any person to participate in amateur radiocommunication from his station, provided that a control operator is present and continuously monitors the radiocommunication to ensure compliance with the rules.

11. In Section 97.87, paragraph (d) is amended and redesignated as (h) and new paragraphs (d), (e), (f), and (g) are added as follows:

§97.87 *Station Identification.*

* * *

(d) Under conditions when the control operator is other than the station licensee, the station identification shall be the assigned call sign for that station. However, when a station is operated within the privileges of the operator's class of license but which exceeds those of the station licensee, station identification shall be made by following the station call sign with the operator's primary station call sign (i.e. WN4XYZ/W4XX).

(e) A repeater station shall be identified by radiotelephony or by radiotelegraphy when in service at intervals not to exceed five minutes at a level of modulation sufficient to be intelligible through the repeated transmission.

(f) A control station must be identified by its assigned station call sign unless its omissions contain the call sign of its associated station.

(h) The identification required by paragraph (a), (b), (c), (d), (e), (f) and (g) of this section shall be given on each frequency being utilized for transmission and shall be transmitted either by telegraphy using the International Morse Code, or by telephony, using the English language. If by an automatic device only used for identification by telegraphy, the code speed shall not exceed 20 words per minute. The use of a national or internationally recognized standard phonetic alphabet as an aid for correct telephone identification is encouraged.

12. Section 97.89 is amended to read as follows:

§97.89 *Points of Communications.*

(a) Amateur stations may communicate with:

(1) other amateur stations, except those prohibited by Appendix 2.

(2) stations in other services licensed by the Commission and with United States Government stations for civil defense purposes in accordance with Subpart F of this Part, in emergencies and, on a temporary basis, for test purposes.

(3) any station which is authorized by the Commission to communicate with amateur stations.

(b) Amateur stations may be used for transmitting signals, or communications, or energy, to receiving apparatus for the measurement of emissions, temporary observation of transmission phenomena, radio control of remote objects, and similar experimental purposes and for the purposes set forth in §97.91.

(c) Notwithstanding the provisions of paragraph (a), no more than two repeater stations may operate in tandem, i.e., one repeating the transmissions of the other, excepting emergency operations provided for in §97.107 or brief periods to conduct emergency preparedness tests.

(d) Control stations and auxiliary link stations may not be used to communicate with any other station than those shown in the system network diagram.

13. Section 97.95 paragraph (a) (1) is amended as follows:

§97.95 *Operation away from the authorized permanent station location.*

(a)

(1) When there is no change in the authorized land station location, the amateur radio station other than a military recreation or an auxiliary link

station may be operated under its station license anywhere in the United States, its territories or possessions as a portable or mobile operation, subject to §97.61.

* * *

14. Section 97.97 is revised to read as follows:

§97.97 *Notice of operation away from authorized location.*

Whenever an amateur station is, or is likely to be, in portable operation at a single location for a period exceeding 15 days, the licensee shall give advance written notice of such operation to the Commission's office specified in §97.95. A new notice is required whenever there is any change in the particulars of a previous notice or whenever operation away from an authorized station continues for a period in excess of one year. The notice required by this section shall contain the following information:

(a) Name of licensee

(b) Station call sign

(c) Authorized station location shown on station license

(d) Specific geographical location of station when in portable operation

(e) Dates of the begnning and end of the portable operation

(f) Address at which, or through which, the licensee can be readily reached.

15. Section 97.103 is revised to read as follows:

§97.103 *Station log requirements.*

An accurate legible account of station operation shall be entered in a log for each amateur radio station. The log shall bear the call sign of the station and the signature of the licensee. The following information shall be recorded as a minimum:

(a) Written entries for all stations which are required only once, or when there is a change thereto.

(1) The signature of the control operator on duty and the call sign of his primary station, if he is other than the station licensee.

(2) The location of the station. Stations in mobile operation may enter the word "local" for amateur radiocommunication conducted within 100 statute miles of the address shown on the station license, otherwise the location of the first and last radiocommunication of each day. Stations in mobile or portable operation shall make an entry showing compliance with §97.97, if required.

(3) The input power to the transmitter final amplifying stage.

(4) The type of emission used.

(5) The frequency or frequency sub-band used for transmitting.

(b) Other entries for all stations which may be recorded in a form other than written but which can readily be transcribed by the licensee into written form:

(1) The dates of operation.

(2) Except for repeater stations, names of persons other than the control operator using the station, either directly or indirectly, for amateur radiocommunication.

(3) A notation of third party messages sent or received, including names of all participants and a brief description of the message content.

(4) The call sign of each station actually contacted, or other purpose of the transmission, i.e., those set forth in §97.89. Stations in mobile operation and repeater stations may omit this entry. Control stations shall enter the call sign(s) of each station in the control link. An auxiliary link station shall enter the call sign of its associated station(s).

(5) All stations shall enter the times when the station is put into, or taken out of, service. Stations other than those in mobile operation, control stations, auxiliary link stations, and repeater stations shall enter the times of commencing and terminating each exchange of radiocommunication.

16. Section 97.105 is revised as follows:

§97.105 *Retention of logs.*

The station log shall be preserved for a period of at least 1 year following the last date of entry and retained in the possession of the licensee. Copies of the log, including the sections required to be transcribed by §97.103, shall be available to the Commission for inspection.

17. Section 97.111 is redesignated as 97.112 and a new undesignated center heading and Sections 97.108 through 97.111 are added to read as follows:

Operation of additional stations.

§97.108 *Operation of a remotely controlled station.*

(a) An amateur radio station may be operated by remote control only from an authorized control point, and only where there is compliance with the following:

(1) The license for the remotely controlled station must list the authorized remote control point(s). A photocopy of the remotely controlled station license must be posted in a conspicuous place at the authorized control point(s), and at the remotely controlled transmitter location. A copy of the system network diagram on file with the Commission must be retained at each control point. The transmitting antenna, transmission line, or mast, as appropriate, associated with the remotely controlled transmitter must bear a durable tag marked with the station call sign, the name of the station licensee and other information so that the control operator can readily be contacted by Commission personnel.

(2) The control link equipment and the remotely controlled station must be accessible only to persons authorized by the licensee. Protection against both inadvertent and unauthorized deliberate emissions must be provided. In the event unauthorized emissions occur, the station operation must be suspended until such time as adequate protection is incorporated, or there is reasonable assurance that unauthorized emissions will not recur.

(3) A control operator designated by the licensee must be on duty at an authorized control point while the station is being remotely controlled. Immediately prior to, and during the periods the remotely controlled station is in operation, the frequencies used for emission by the remotely controlled transmitter must be continuously monitored by the control operator. The control operator must terminate transmission upon any deviation from the rules.

(4) Provisions must be incorporated to automatically limit transmission to a period of no more than three minutes in the event of malfunction in the control link.

(5) A remotely controlled station may not be operated at any location other than that specified on the license without prior approval of the Commission except in emergencies involving the immediate safety of life or protection of property.

(6) A repeater station may be operated by radio remote control only where the control link utilizes frequencies other than the repeater station receiving frequencies.

§97.109 *Operation of a control station.*

(a) Amateur frequency bands above 220 MHz, excepting 435 to 438 MHz, may be used for emissions by a control station. Frequencies below 225 MHz used for control links must be monitored by the control operator immediately prior to, and during, periods of operation.

(b) Where a remotely controlled station has been authorized to be operated from one or more remote control stations, those remote control stations may be operated either mobile or portable.

§97.110 *Operation of an auxiliary link station.*

(a) An auxiliary link station may use amateur frequency bands above 220 MHz excepting 435 to 438 MHz for emissions. Frequencies below 225 MHz used by an auxiliary link station shall be monitored by the control operator immediately prior to, and during, periods of operation.

(b) An auxiliary link station may only be used for fixed operation from the location specified on the station license, and only when its associated station(s) is operated from its authorized land location.

§97.111 *Operation of a repeater station.*

(a) Emissions from a repeater station shall be discontinued within five seconds after cessation of radiocommunication by the user station. Provisions to automatically limit the access to a repeater station may be incorporated, but are not mandatory.

(b) The transmitting and receiving frequencies utilized by the repeater station shall be continously monitored by the control operator immediately prior to, and during, periods of operation.

(c) A repeater station may be concurrently operated on more than one frequency band, provided the necessary showings have been approved by the Commission for each frequency band of operation. Crossband operation of repeater stations is prohibited, i.e. both input (receiving) and output (transmitting) frequencies for a particular repeated transmission must be within the same frequency band. Operation on more than one output frequency on a single frequency band is prohibited except when specifically approved by the Commission. Repeater stations authorized to operate in conjunction with one or more auxiliary link stations may utilize an input frequency in a different frequency band provided the input frequency of the auxiliary link station(s) is in the same frequency band as the output frequency of the repeater station.

(d) A repeater station shall be operated in a manner so as to assure that the station is not used for one-way radiocommunication other than provided for in §97.91.

(e) A station licensed as a repeater station may only be operated as a repeater station, excepting for short periods for testing or for emergencies.

18. In Section 97.193, the introductory text of paragraph (a) is amended, and a new paragraph (e) is added to read as follows:

§97.193 *Frequencies available.*

(a) Except as provided in paragraph (e) of this section, the following frequency and frequency bands and associated emissions are available on a non-exclusive basis to the individual class of stations or units of such stations in the Radio Amateur Civil Emergency Service.

(e) A repeater station in the Radio Amateur Civil Emergency Service may operate on any frequency, and with any associated emission, above 50 MHz listed in paragraph (a) of this section, except for 220 MHz to 333 MHz.

19. Appendix 2 is amended by adding a footnote to Section 1:

Sec. 1. Radio communications between amateur stations of different countries[1] shall be forbidden if the administration of one of the countries concerned has notified that it objects to such radiocommunications.

20. Appendix 5 is added, reading as follows:

APPENDIX 5
DETERMINATION OF
ANTENNA HEIGHT
ABOVE AVERAGE TERRAIN

The effective height of the transmitting antenna shall be the height of the antenna's center of radiation above "average terrain." For this purpose "effective height" shall be established as follows:

(a) On a United States Geological Survey Map having a scale of 1:250,000, lay out eight evenly spaced radials, extending from the transmitter site to a distance of ten miles and beginning at 0°, T (0°, 45°, 90°, 135°, 180°, 225°, 270°, 315° T). If preferred, maps of greater scale may be used.

(b) By reference to the map contour lines, establish the ground elevation above mean sea level (AMSL) at 2, 4, 6, 8, and 10 miles from the antenna structure along each radial. If no elevation figure or contour line exists for any particular point, the nearest contour line elevation shall be employed.

(c) Calculate the arithmatic average of these 40 points of elevation (5 points of each of 8 radials).

(d) The height above average terrain of the antenna is thus the height AMSL of the antenna's center of radiation, minus the height of average terrain as calculated above.

Note 1: Where the transmitter is located near a large body of water, certain points of established elevation may fall over water. Where it is expected that service would be provided land areas beyond the body of water, the points at water level in that direction should be included in the calculation of average elevation. Where it is expected that service would not be provided to land areas beyond the body of water, the points at water level should not be included in the average.

Note 2: In instances in which this procedure might provide unreasonable figures due to the unusual nature of the local terrain, applicant may provide additional data at his own discretion, and such data may be considered if deemed significant.

[1] as may appear in public notices issued by the Commission.

NEW FCC REGULATIONS

Effective November 22nd there will be some changes in the 10, 15, 40 and 80m bands. These changes are the result of the efforts to set up more voice bands in recognition of the high percentage of amateurs using voice instead of CW.

On the 80m band the Extra Class phone segment was extended 25 kHz down to 3775 kHz. On 40m the phone band was extended down to 7150, thus moving the Novice band down to 7100-7150 kHz. American stations outside of Region 2 may also use phone in the 7075-7100 kHz band. The 15m Novice band was cut back, with 21.2-21.25 being deleted from Novice use. A new Novice band was opened on 10m, running from 28.1 to 28.2 MHz. Because of the extensive changes in the Novice bands the requirement for crystal control was removed. How about that!

NEW FCC REPEATER PETITIONS

PETITION: To extend amateur repeater operation to the 440–442 MHz band.

The recent Commission report and order (8-29-72) restricts repeater operation in the amateur 420 MHz band to the frequencies 442–450 MHz.

Since this is completely contrary to the self regulating frequency allocations set up by the amateurs, a system which has been working quite satisfactorily, and which has been responsible for the orderly growth of the 420 MHz band in all parts of the country, implementation of the new Commission regulation would disrupt the work of the last decade – it would cause considerable hardship and expense – it would be a slap in the face of those serious amateurs who have labored so hard over the years to keep the growth and development of this band orderly.

THE 420 MHz PLAN

Amateurs have been working together with remarkably good results to bring about an orderly use of the 420 MHz band. When you consider the variety of groups and individuals involved, the self restraint has been admirable.

Repeaters and repeater control links have been self-allocated to the 440–450 MHz segment of the band, with the exception of southern California where this segment has been filled and some allocations have been made in the 420–430 MHz segment. The allocation by the Commission of repeaters to the 442–450 MHz segment of the band could have the impact of forcing repeater link stations to move out of this segment and into the 420–430 MHz part of the band – a part which has presently been allocated by amateurs to fast scan television experimentation.

There has been no demonstrated need for a change in the amateur self allocation scheme. It has been working well and with effectiveness. The heavy hand of the Commission was not needed in any way and is quite undesirable.

If the Commission would limit itself to regulations for which there is some demonstrated need, the amateur service would be able to progress and grow with the times.

Amateur radio is important to the United States and to the world. The future of business and government is largely electronic and any moves made by the Commission which tend to limit the number of youngsters who take up this hobby which is the entryway to a professional career cannot be considered as other than detrimental to the good of the country.

The Commission is all too familiar with the future of electronics and communications as a major part of the activities of the Commission are involved with trying to cope with the changes that these developments bring about. There is going to be a need – a great need – for more and more engineers and technicians to design, build, install, operate and service the electronic future that all of us see ahead. What a disaster if the Commission should make moves today which would make amateur radio less attractive as a hobby and thus precipitate a shortage of trained professionals a few years hence.

The results of the Commissions' adventure with "incentive licensing" should serve as a warning. To some degree that change in the amateur regulations – and the threat of it – turned away tens of thousands of youngsters who might otherwise have become radio amateurs. How much of the sudden drop in growth of amateur radio was attributable to incentive licensing and how much to the FCC license fees is debatable, but the effect is not.

During the ten year period from 1951 to 1961 the number of operators grew from 88,729 to 216,720 (FCC figures), a growth of about 9% per year average. During the period 1961 to 1971 the growth was only about 68,000, an average of about 2½% per year. During the years of Commission indecision on incentive licensing the growth was miniscule, going from 256,237 in 1964 when the Commission put the matter on the docket to 260,294 in 1968 when it was finally concluded. During four years the amateur service grew by only 4,000 operators.

Had it not been for the interference by the Commission it seems likely that the growth pattern of the service would have continued as it had for many previous years and we would today have about 600,000 operators. When one considers what that would mean in terms of service in times of emergency – in manpower lost to industry and the military – it is a terrible loss.

The Commission is begged to stop this trend toward unnecessary restriction of the amateur service. When there is no clearly demonstrated need for regulation of amateurs we beseech the Commission to leave us alone – and there is no clear or even indistinct call for regulations prohibiting the use of amateur repeaters in the 440–442 MHz segment of the band.

PETITION:

It is hereby petitioned that the FCC permit repeater operation in the 440–442 MHz amateur band. It is requested that section 97.111(c) be changed to indicate that repeaters may use the 440–450 MHz segment of the band; and that in section 97.67 the table of authorized power be changed to read 440 MHz instead of 442 MHz.

Wayne Green
Peterborough NH 03458
18 September 1972

PETITION: To permit crossband linking of repeaters.

The recent Commission report and order (80334) prohibits crossband operation of repeaters (97.111(c).

This ruling would seem to be in basic opposition to the very fundamental spirit and purposes of the amateur service. It is unnecessarily restrictive in that it prevents the application of amateur ingenuity which would otherwise be devoted to the development of multiband communications systems – systems which could hardly fail to be of extreme value in times of emergency – systems which would tax amateur ingenuity and further demonstrate his ability to design and build equipment to meet demands far beyond those of commercial applications.

CLASSES OF LICENSE

With the restriction of repeaters in all of the amateur bands to frequencies allocated to all classes of license, from Technician through Extra Class, there cannot be any question of the repeating of a Technician operating on his own authorized frequencies into a band for which he is not licensed. Thus there can be no such excuse given for limiting or prohibiting cross band operation of repeaters.

FREQUENCY CONSERVATION

The availability of several different 220 MHz transceivers would seem to put any questions of overoccupancy of repeaters in any one area far enough in the future so there could be little reason for ruling against current

uses of repeaters on the grounds of possible distant future crowding.

The fact is that even in the most congested areas we have adequate spectrum space for double or triple the number of repeaters that are presently active in the amateur service. Further, few of the repeaters are kept active for more than a few hours a day.

It is interesting to note that such time consuming services as autopatch tend to be used less and less as other uses develop for a repeater. The busiest repeater in the country, WA2SUR, has autopatch facility, but the over 400 active users of the repeater keep it so busy that operators wanting to use the autopatch switch channels to less active repeaters.

The same tendency would tend to limit the use of any repeater for cross band operation, in all probability. Cross band operation would generally tend to be used during times when regular repeater activity is at a minimum.

This has certainly proven to be the case with the WA1KGO repeater. This repeater is active on 146.19–146.79 MHz and can be interconnected with 52.525 MHz by use of tone access. In practice the 146 MHz activity takes precedence and cross band operation is only attempted when the repeater is not otherwise in use.

It would seem unreasonable to prohibit cross band connection of repeaters on the basis of frequency conservation.

CROSSBANDING BASE STATIONS

Since there is no prohibition of interconnecting a 146 MHz signal on any other band when an intermediary operator is present, it does not seem reasonable or logical to differentiate against repeaters. If there are adequate safeguards built into the system, an automatic cross connection between two bands should be the same as if it were being done by a third operator.

There is nothing illegal if I am in contact with an amateur station on 146 MHz and one on 52.525 MHz simultaneously in a three-way contact with me rebroadcasting each of the other two operators so they can hear the entire contact. For that matter there is nothing illegal in my transmitting any class of license on any band permitted me by my license as long as I am in control.

The new regulations spell out in detail that someone must be in control of a repeater station at all times – so where is the difference between the repeater and a base station? In each case there is an operator in constant control, yet with the base station cross banding is permitted and with the repeater it is not. This does not seem logical, reasonable or fair.

INCENTIVE LICENSING?

The concept that amateurs might use repeaters to circumvent the band allocations set up in recent years for different classes of license has no basis in fact. It is technically possible, of course, for an amateur with a Technician license, to operate through a repeater and work 20 meters, complete with a kilowatt, rotary beam, and first class location and receiver. But since this has never happened, to my knowledge, and seems unlikely to happen, the need for regulations prohibiting it seem uncalled for – and the side effects of the regulations so damaging and prohibitive to amateur ingenuity and progress as to be worthy of immediate reconsideration.

The amount of ingenuity required for automatic remote operation of a low band station seems sufficient to be self regulating.

There is something to be said about the possibility of the limited use of cross band to a lower band as an incentive toward getting a higher class of license. The Technician who has never made an international contact might be impressed enough if he were able to occasionally do this via a repeater to get a higher grade of license so he could set up his own low band station. In my experience, many Technicians have no idea what they are missing.

But, since the repeater regulations restrict all repeater operation to bands usable to all classes of license above Novice, the matter of repetition outside of the license restrictions is not pertinent.

INTERCONNECTING SYSTEMS

Amateurs have repeater systems operating in all of the VHF bands, 52 – 146 – 220 – 450 MHz. Each band is relatively isolated at present, with one group on 52 MHz, another on 146 MHz, etc. Indeed, unless one is to jam a car full of expensive equipment, there is no practical way of operating all of these bands with a mobile station. Four transceivers and the array of antennas on the car would provide a very tempting target for thieves.

A four band mobile installation could easily cost more than the car. Even using the latest solid state equipment, it would take a large car to leave room for the driver once the four stations were installed.

If a few repeaters were permitted to interconnect the different systems, it would be possible for a mobile operator to talk with any of the four groups in his vicinity. Hopefully it is not necessary to point out the tremendous value of this flexibility in time of emergency. Without such an interconnection the four systems would be individual and in many instances three of them would be wasted.

With suitable safeguards it should be possible to permit repeaters to be interconnected. Since all repeaters are under constant supervision and control, they can be shut down at any time that trouble develops, though amateur ingenuity should not be seriously taxed in providing automatic disconnection of such functions when problems arise.

PETITION:

The Commission is requested to permit crossbanding of repeaters, provided adequate safeguards are built into the system to disable it in case of difficulty.

A deletion of the second sentence of section 97.111(c) is requested.

Wayne Green W2NSD/1
Peterborough NH 0345818
September 1972

PETITION: Expansion of repeater frequencies in the 220–225 MHz amateur band.

REPEATER MAIN USERS

Though amateurs have had the 220–225 MHz band for many years, the activity in that band has been slight. This has been the result of many circumstances such as the lack of suitable military surplus equipment which could be modified for operation on this band, the lack of commercial surplus equipment for the band, the lack of commercial amateur equipment for the band, the power limitations which prevailed for that band for many of the earlier years thus discouraging moonbounce and weak signal work, the narrowness of the band which precluded television experimentation, the availability of commercial and military surplus equipment for the adjacent amateur bands (thus encouraging their use over the 220 MHz band), the pre-emption of the band for military use on a priority basis, and other considerations.

The rapid growth of repeater FM operations in the 146 MHz band indicate that, even with the expansion of that band to the 147 MHz segment, an end is in sight in many areas of the country for repeater channels. The obvious band for further repeater development is the 220 MHz band. Indeed, amateurs and repeater groups have recognized this and a series of FM symposiums have been held to coordinate the development of repeaters in this band. Over two hundred repeater groups have agreed to set up repeaters on the 220 MHz band as soon as practical. Many have already fulfilled this agreement and there are an estimated 70 repeaters actually in operation around the country at this date.

Since the users, other than FM repeaters, have not successfully developed the 220 band in the years that it has been available, it does not seem likely that any great influx of them can be expected in the future. The fact is that 220 MHz offers little for the AM or CW operator over operation on 144 MHz. There is no shortage of open channels on the 144 MHz band for these operators, and there are far more stations to contact. The few stations active on the 220 band (other than repeaters) are not likely to attract much more company.

There is no amateur radio development in sight on any horizon which would provide activity in any substantial numbers in the two MHz left open by the new regulations.

In the forseeable future it would appear that the bulk of the activity that can be expected to develop on the 220 MHz band would be repeaters. The need is there — the equipment is being manufactured — the interest of the amateurs is there. Everything would appear to be favorable for extensive repeater use of this band.

In the face of this need and prospective growth, the deletion of 40% of the band from repeater use would seem to the detriment of the amateur service.

NEW EQUIPMENT

Several manufacturers have taken note of the growth possibilities of the amateur 220 MHz band and have been working diligently to provide good FM transceivers for this band. TPL has a 220 transceiver in production which will sell for around $250. Henry Radio has a fine 220 FM transceiver which should sell at around $300. The Clegg 21 is in production. And several other companies are rushing transceivers into production for this band.

Both TPL and Clegg are also working on repeaters for the band and they should be available before the end of the year.

The lack of equipment which has previously limited the use of this band by amateurs would seem to be ending shortly.

SELF REGULATION

Amateurs have clearly shown the Commission that they have little need for restrictive rules and regulations and are quite capable of keeping their own house in order. This has been particularly true as far as the 220 MHz band is concerned.

The FM symposiums held earlier this year in the east, midwest and west developed national agreements on 220 MHz repeater input and output channels, repeater channel allocations, frequency coordination to keep interference to a minimum, deviation standards, simplex channels, control frequencies, etc. Repeater councils have been established in most parts of the country to deal with any problems that do come up.

WHY NOT OPEN 220–222 MHz?

Since the use of this band by other than FM repeaters is negligible and would seem to be negligible for the forseeable future, there would seem to be no adequate reason for the Commission to prohibit the use of the entire band by repeaters.

Perhaps it should be pointed out that the amateurs have agreed to leave the 222–223 MHz segment of the band open for non-repeater use, and have also agreed to leave the lower part of the 220 MHz segment open for continued use by the few present AM and CW users.

What purpose can there be for the Commission to make a rule which will essentially leave two MHz of this band open and almost totally unused? The only possibility that suggests itself is one which is certainly unbecoming of the Commission, though it seems almost inescapable: this regulation would seem to pave the way for a deletion of all or part of this two MHz from the amateur service and thus make it available for citizens band service as is being fervently urged by the Electronics Industries Association.

In the absence of any Washington lobby on the part of the amateurs, there would seem little that amateurs can do to preserve their bands against the pressures of money and influence of big business. The amateurs have depended entirely upon the Commission to be honest and protect their future, having no organization of their own to lobby for them and thus provide this protection.

The net gain to amateurs using the 220 MHz band, should the Commission return the lower two MHz for repeater use, would be one MHz, since the middle MHz has been allocated to non-repeater uses. This segment, from 222–223 MHz is in active use by non-repeater groups right now and has several advantages which make it desirable for this use: the freedom from radar interference which is more serious in the lower parts of the band — and the freedom from adjacent channel interference from television transmitters (and interference to television sets) which results from operation on the lower part of the band. The upper part of the band suffers seriously from spurious emissions of television sets and is less desirable as a result. The result of these and other factors is that the most valuable part of the band for weak signal operations is in the middle part of the band in most areas of the country.

Repeater use of the high end of the band for inputs would seem to be ideal since most repeater receivers are normally situated far enough away from television sets so they would tend to receive little interference from spurious emissions.

The low end of the band would seem better for repeater outputs since their remoteness from television sets would cause much less adjacent channel interference or front end overload to television sets.

The plan that emerged from the FM symposiums would seem to best consider all of the presently known factors as far as amateur utilization of the band is concerned — with the exception of leaving two MHz open and unused for allocation to a new citizens band.

The difference in the number of repeater channels which will be available to amateurs is important. If repeaters are kept to but 3 MHz of the band this would permit perhaps 34 repeater channels using 40 kHz splits instead of the 50 that would result from using 4 MHz.

There are an estimated 30,000 radio amateurs presently active using FM repeaters on 146 MHz. The total population of licensed amateurs is presently about 285,000, according to the latest FCC and Callbook figures. If we make allowances for second stations, licensed wives and children, this still gives us about 210,000 amateurs who might be users of repeaters.

At present amateurs are using approximately fifty 146 MHz repeaters in the New England area. If we project this forward we find that we could need as many as 350 repeaters in the area to handle the activity. The two meter band will probably be able to hold one hundred of these. Obviously the 220 MHz band will be strained to provide the repeater channels that could be needed.

PETITION:

The FCC is hereby petitioned to reopen the entire 220–225 MHz amateur band for repeater use.

It is hereby requested that section 97.61(c) be ammended to read 220–225 MHz instead of the present 222.0–225.0 allocation.

Wayne Green W2NSD/1
Peterborough NH 0345818
September 1972

PETITION: To drop the requirement that a repeater be constantly monitored by a control station during operation.

Amateur automatic relaying stations — repeaters — serve several uses. It is important to consider these uses when devising restrictions and setting them up to limit possible misuses, while not interfering with the uses.

Repeater stations extend the range of communications of amateur base, mobile and hand transceivers, making it possible for amateurs in a fairly wide area to establish contact. As an example, the repeater station atop Mt. Mansfield in Vermont makes it possible for amateurs in northern New Hampshire, northern Vermont, northeastern New York and adjacent sections of Quebec and Ontario to maintain contact with ten watt mobile units. For instance, I have no trouble using this repeater from New Hampshire, fifty miles away, with a one watt handy-talky to talk with mobile amateurs in Ontario over 200 miles away.

The amateur service provides a supply of trained operators and equipment for use in times of emergency, as well as technical developments which benefit industry and the country. But amateur radio is able to provide the service that it does because of the hobby it provides. The equipment amateurs buy or build or convert is bought with personal funds – funds on which the government has already extracted an income tax. Amateurs will continue to invest this time and money as long as the Commission does not prevent the enjoyment of the hobby which spurs this investment.

The latest report and order by the Commission is not calculated to increase the enjoyment of the hobby – and to that extent will be detrimental to the service that amateurs provide.

The Commission must be aware that in every serious emergency communications falls upon local amateurs. The recent devastation in Pennsylvania was typical of the emergency situations which amateurs encounter and can serve as an example and model.

After trying for several days to handle emergency communications via the lower amateur bands, the importance of a repeater was so apparent that one was flown from a factory over a thousand miles away and set up in the disaster area. The Civil Defense communications, largely set up in basements, were flooded out. Police were too busy with their own problems to provide health and welfare message service or to help the stricken Civil Defense groups. Citizens band operators tried to help, but interference on their channels from skip stations running high power, their lack of range due to low power, and their lack of training in handling messages rendered them only of limited use. Only amateur radio was able to step in and provide the short, medium and long range communications needed.

Once the repeater had been set up, the emergency coordinators in the area had to put out a call for portable and mobile FM stations and operators to come from outside to help since the local amateurs were not set up for FM and repeaters. A helicopter was sent to the Clegg factory to pick up a dozen of the newest FM transceivers and these were put to immediate good use by local amateurs. FM amateurs from hundreds of miles around responded.

If FM and repeaters had already been established in the flood area it would have been possible for amateurs to provide much better service early in the emergency. It would seem important for the Commission to keep in mind the end effect of each new regulation and weigh it in terms of how it might affect the communications capability that amateurs can provide. The requirement that a control operator continuously monitor a repeater while it is in service is so extremely restrictive as to be severely damaging to the amateur service.

The Commission requirement that a repeater station be controlled via a control and link station on a band above 225 MHz sets definite limitations as to the practical number of control points that can be used, both from a license fee and cost of equipment standpoint. The addition of 450 MHz control equipment to the 146 MHz transceiver in a car would more than double the investment necessary for the mobile installation – and would require a second communications type antenna on the car, thus making it stand out substantially from others and be an inviting target for thieves.

The practical result of the Commission requirement for monitoring at a control point during repeater service is that few repeaters would be in service through the night or during regular working hours of the day. There would be exceptions, of course, where a control operator happened to be an engineer at an all night radio or television station, or the like. These would more likely be the exception rather than the rule.

Repeaters which are turned off a good deal of the time are not very valuable in times of emergency. In some areas it is possible to have a choice of repeaters and it might be feasible to try one channel after another to find a repeater in service. In most areas a mobile operator has little choice and if the repeater within his range is off he is helpless.

It is much more likely that someone somewhere might be listening to the repeater, even though all of the four or five control operators might be asleep, and provide help. And, in the case of the repeater with autopatch, no operator at all is needed to provide help since police or others can be notified directly through the repeater and the telephone line. The proliferation of scanning receivers makes it even more likely that someone who is awake would be on hand to render service in time of emergency.

Emergencies come in all sizes, from earthquakes and wars to a warning to the wife that you are going to be late. The Commissioner who does not consider notification of late arrival to a wife an emergency must be a bachelor.

There are lesser emergencies where repeaters are helpful. Many amateurs use repeaters when they are driving late at night and through the early morning hours to help keep them awake. Two drivers a hundred miles apart can keep each other awake and alive. To be personal about it, I now undertake long drives at night that I would never undertake without the safety of open repeaters along the way. I know that I will not fall asleep and that should anything happen to my car that I will be able to reach help immediately. If all these repeaters were to be turned off, as the Commission regulations will almost certainly force, many amateurs would suffer along with me.

In this day of integrated circuits there is little problem for amateurs to build and maintain the sophisticated circuits which will enable a repeater station to operate without immediate direct control. With timers set to disable the repeater when trouble develops anywhere in the system, little can go wrong. The fact is that there are about one thousand amateur repeater stations in operation in the U.S. today and the number of problems they cause are very few. The Commission requirement to continuously monitor the input and output of the repeater does not seem to serve the purpose of correcting any existing problem.

As the editor and publisher of the one amateur magazine which has specialized in FM and repeaters and the publisher of a monthly bulletin providing communications to all of the repeater users and operators in the northeastern U.S., and as the publisher of virtually all of the many books on the subject of FM and repeaters, I am perhaps in better communications with the repeater situation as it is in 1972 than most other people.

I would ask that the Commission keep in mind that the comments received on Docket 18803 were sent in over two years ago and reflect, if anything, the state of the art at that time and the thinking of those with experience in the field at that time.

Since then FM and repeaters have grown enormously and the state of the art has changed markedly. There are about 400% more amateurs using FM and repeaters today – there are perhaps 300% more active repeaters, minimum.

In my experience the problems that amateurs are having with repeaters are few and, in virtually every case, are easily solved by the amateurs themselves. There has been no demonstrated need for extensive and extremely restrictive regulations. Repeaters are quite capable of being set up by amateurs to run automatically without perpetual monitoring and it is in the interest of the hobby and the service it provides that repeaters be so set up in most cases.

Amateur repeater technicians and groups will provide any sort of reasonable safeguard that the Commission requires to assure that an automatic unmonitored repeater station is not operated in a way that will cause problems for other services or for other amateurs. The repeater councils have clearly demonstrated that amateurs are quite capable of self government and handling all but the most serious problems that arise. Amateurs have been able to arbitrate and agree on repeater channels, on interference between repeaters on the same channels, and all other problems attendant to the growth of this valuable service. The fact that problems have arisen is of much less importance than the demonstrated ability of the amateurs to surmount them unaided by the Commission. About the only serious difficulties where amateurs have need of help from the Commission has been in cases of illegal jamming of a few repeaters and the occasional use of abusive language. These cases have been so few and far between that they are not and have never been a substantial problem. And this is a problem that amateurs face on all bands, not just via repeaters.

The Commission gives no reason for the ruling on continuous monitoring, so it is difficult to provide arguments. Indeed, it is difficult to even imagine why such a ruling could ever have been made. It seems to serve no useful purpose and seems so unnecessarily prohibitive and restrictive to the whole fabric of amateur radio as to be worthy of immediate change.

PETITION:

To delete the ruling which requires a repeater control operator to monitor the input and output of the repeater continuously. It is requested that the words "and during," in section 97.111b be struck from the regulations, and that 97.109a and 97.110a be changed to eliminate "and during" in the cases of remote control or link operation of a repeater.

Wayne Green
Peterborough NH 03458

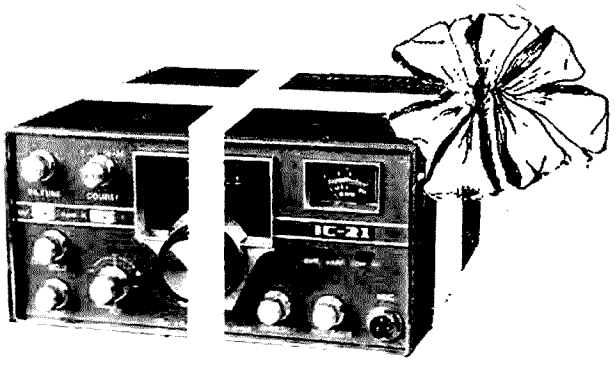
18 September 1972

CRYPTOGRAM

IGC GCOWS GOLB RY ULVCLVUIUWC JRWCDLKCLI GOV EFVI BCOAI O TDFCA ZARX IR IGC KRVI CQTUIULJ OLB YFL OVHCTI RY OKOICFD DOBUR UL KOLS, KOLS SCODV.

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The **INOUE IC-21** at **$399.95** is the premium 2 meter transceiver on the market today. Surely you deserve only the best as your very own Christmas present. I know she will approve, as nothing makes the Christmas Day more enjoyable than having a happy 2 meter ham.

JUST TELL HER TO SEND A CHECK TODAY TO:

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We'll do our part to make a Merry Christmas for you by immediately shipping out your rig. Also, we're going to enclose a little Christmas present for her for being so nice to both of us.

Ken W. Sessions, Jr. K6MVH
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Los Angeles, CA 90066

LOW NOISE ECONOMY PREAMP FOR 2M

Low gain is almost a meaningless parameter in an rf preamplifier specification unless some notation is made about the noise characteristics of the circuit. A gain of 20–30 dB is not uncommon in a VHF preamplifier with a single semiconductor of modern vintage. But if the active device tends to generate and amplify noise, that healthy signal could be reduced to such an extent that copy is actually better with the preamp completely out of the receiver circuit. A signal-to-noise-ratio measurement made before installing the preamp should, under ideal conditions, read the same with the preamp *in* the circuit provided the *specified* gain is actually the effective gain – which, unfortunately, is rarely the case. In practice, the effective gain of a typical two meter preamp is considerably less than half the rated gain!

Bandwidth is another parameter worthy of a builder's consideration. A broad amplification curve might be a real blessing for the frequency-hopper who operates at the low end of the band one night and at the other end the next, providing he's not trying to operate from an area noted for spectrum congestion. The fact is, the broader the bandwidth of the preamp, the more likely the receiver will be to be "swamped out" by strong signals on adjacent frequencies. Obviously, then, for such applications as FM repeaters, and for metropolitan operation in general (where plenty of strong signals abound), selectivity would take precedence over broadband capability.

The two meter preamp described here represents what I feel to be a sound compromise with respect to bandwidth and gain. It is relatively broadbanded, but not so much as to allow tuning of the entire two meter band without some retuning. It is capable of resisting strong signals (above a millivolt) at adjacent 30 kHz points without desensitizing the receiver – a feature that qualifies it well for use with repeaters. The effective gain of this preamplifier is 14 dB; and the noise contribution is as low as the state of the art will allow.

The preamp owes its extremely low noise figure to the single HEP 802, a low-cost VHF junction-type field-effect transistor produced by Motorola for the hobbyist and experimenter market.[1] FETs in general have lower noise figures than ordinary bipolar transistors, and the junction FET has a significantly lower noise figure than the metal-oxide (MOSFET) type.

The circuit presented here -- designed, by the way, by Motorola engineers – uses the FET in a common-gate configuration. While common-gate amplifiers don't exhibit the sometimes astronomical gain that can be achieved with common-source or common-drain circuits, other factors make it an ideal choice for VHF applications. Chief among those "other factors" is the devilish *Miller effect*, the FET's traditional "most serious threat" to VHF applications. The Miller effect is the name applied to a FET's characteristic high-frequency feedback capacitance problem; as the frequency goes up, the gate-to-drain capacitance increases and actually appears *across* the amplifier, making the input impedance in effect a capacitive reactance.

Fortunately, while the Miller effect is horrendous with common-source amplifiers, and just plain terrible for common-drain configurations, it is a negligible consideration with the common-gate amplifier hookup. Clever engineers have developed methods for skirting the Miller effect, such as cascoding (with an "o" not an "a") the common-gate FET with a common-source type[2], but these add complexity – and complexity means expense. Considering the various tradeoffs, the most practical approach appears to be to settle for a little less overall gain than what is technologically possible in return for improved selectivity and a noise figure that is virtually incomparable.

Construction

The schematic diagram is shown in Fig. 1. As shown, the circuit represents a conservative use of components – a feature that is attractive from both the standpoint of economy and miniaturization. If you've worked with FETs at VHF before, you'll have no trouble with this excellent-performing circuit.

Just remember to keep the leads short; make good solder connections; don't overheat the FET leads (use sockets); and use effective shielding.

It's always a good idea to use printed circuit boards for projects like this, of course, but I didn't. The very good performance of my own unit serves as proof that a small piece of Vector board and point-to-point wiring with solid conductors can be as effective (and as small) as a printed circuit – and it *is* a darn sight less trouble.

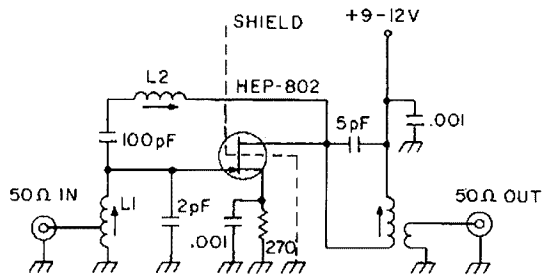


Fig. 1. This single-FET preamp offers an ideal compromise between selectivity and gain; not easily swamped by adjacent frequency signals, it will provide better than 14 decibels of signal improvement for fixed-frequency two-meter operation. Coil values are given in the text.

The preamp contains three coils wound on forms, plus one loop overwind. I used ceramic coil forms with 1/4" brass slugs. Inductor L1 consists of 5-1/2 turns of 26 gauge solid wire (tinned copper) wrapped on the slug-tuned form. This coil should be tapped 1-1/4 turns in from the ground end. Coil L2, also on a slug-tuned form, is 9-1/2 turns of 34-gauge wire. L3 is 5 turns of 26 gauge wire, and L4 is 1-1/4 turns of the same type of wire wrapped around the lower end of L3.

To avoid power-supply problems, I used a simple 9V transistor radio battery to operate my preamp. But for some applications, such as those involving use with a repeater, a battery would be impractical in spite of the preamp's low power consumption. The preamplifier's input voltage range, however, is broad enough to allow connection to a 12V source (rectified and filtered repeater filament supply, for example, or auto battery for mobile installations) with no circuit modifications.

Performance Checkout

If you plan to use the preamp with an AM receiver, you can adjust it for optimum performance in this fashion: first connect the antenna directly to the receiver and tune to a spot where there are no signals (but close to the frequency of maximum interest for you). If your S-meter has an adjustment

pot, set it to zero; if not, simply note the average no-signal reading. Then set the preamp's slug-tuned coils (L2 and L3) to about mid-position and apply power to the preamp. Disconnect the antenna from the receiver, place the preamp in line, and connect the preamp's output to the receiver antenna terminal. Slowly adjust the L2 slug for a maximum S-meter indication, then adjust L3. L2 is slightly more critical than L3, and it should be readjusted after each L3 adjustment. The S-meter reading should increase by at least two units. If broadband operation is desired, adjust L2 at the lower end of the frequency range you want and adjust L3 at the upper end. Then trim L2 for identical S-meter indication at both ends of the range.

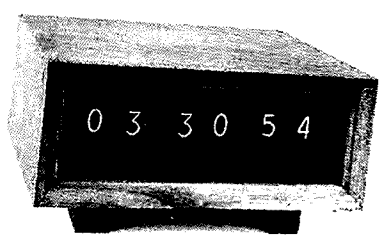
If the preamp is to be used with a repeater, you'll probably have some test equipment on hand. If you have access to a signal generator and an ac voltmeter, you're in luck. Set the ac voltmeter to the decibel range (0–10V ac) and connect the leads to the speaker terminals. Turn on the receiver and open the squelch. Then adjust the receiver volume control for a reading of plus 20 dB on the meter. (If your ac voltmeter has no dB scale as such, adjust the receiver volume control for a reading of 7.8V on the 10V ac scale of a 20,000Ω per volt instrument.)

Connect a signal generator (properly warmed up for stability, of course) to the receiver without the preamp in the circuit, and increase the generator output until the meter reading drops to plus 14 decibels (6 dB quieting). This reading will be just under 4 volts on the 10-volt ac range. Recheck the generator for frequency stability, then insert the preamp, with power applied, between the receiver and the generator. Adjust L2 and L3 for minimum indication on the voltmeter – without readjusting the signal generator. If you've done a good job on the preamp, the adjustment operation should bring the meter reading down to well below zero decibels (less than 0.6 volt on the ac scale).

. . .K6MVH

1. "Tips on Using Fets," Motorola Semiconductor Products, Box 20924, Phoenix AZ 85034.
2. "An Introduction to FETs," Siliconix, Inc., 2201 Laurelwood Rd., Santa Clara CA 95054.

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Questions & Answers Part IV

66. How are grounded-grid amplifiers used in electronic circuits? List some advantages and disadvantages of their use. Describe the input impedance characteristics of a grounded-grid amplifier.

A. Grounded-grid amplifiers are used in rf stages of both transmitters and receivers, but for different reasons. In receivers, the grounded-grid circuit eliminates the need for neutralization of triodes, and permits simple low-noise stages to be designed. The grounded-grid configuration also provides better voltage gain at higher frequencies than can be achieved in other configurations.

In transmitters, the grounded-grid circuit has become popular because of its low input impedance and ability to "feed through" excess power, making it ideal for bringing the output of a medium-power SSB transmitter up to the legal limit.

Advantages of the grounded-grid circuit include freedom from the neutralization requirement, relatively constant load upon the driving source, voltage gain comparable to that of a grounded-cathode circuit, and feed-through of excess driving power.

Disadvantages include the requirement for more driving power than required by more conventional circuits, the low imput impedance (which at times is an advantage), and the requirement that the preceding stage be modulated if the g-g stage is to be modulated.

Input impedance, as mentioned, is low; 50 ohms is an approximate typical value. Output impedance is high. The circuit has no current gain, and does not reverse signal phase.

67. What constitutes a parasitic antenna element?

A. A parasitic antenna element is any antenna element which is not electrically connected to a driving feedline, but operates by means of re-radiation of received energy.

68. What is the image-response of a receiver? How can it be reduced?

A. Every superhet receiver has the capability of responding to signals at two distinct input frequencies, for a single setting of the local oscillator. One input frequency is that which, when mixed with the local-oscillator signal, produces the i-f as the difference between input and local-oscillator frequencies, and the other is that which, when so mixed, produces the i-f as the difference between local-oscillator and input frequencies. That is, one is below the local-oscillator signal, and the other is above, by

the amount of the i-f. Only one of these two possible responses is the desired signal; the other is called the "image." The choice as to which is desired and which is image is made at the time the receiver is designed. The ratio between desired-signal strength, and image-signal strength (assuming equal-level input signals) is the image response criterion, and is usually expressed in dB of rejection of image. Image rejection can be improved by increasing selectivity of the circuits preceding the mixer, or by using a higher i-f, which separates the desired and image signals by a larger degree. Both remedies can be used.

69. What is a third party agreement? What countries have agreements with the United States?

A. A third party agreement is a special agreement between two nations, in which each agrees to permit its radio amateurs to handle messages for third parties in international communications between the two. In the absence of such special agreements, third party messages are prohibited.

At the time of writing, the United States had such agreements with at least 22 countries, all in the Western Hemisphere except Israel and Liberia. The list is subject to relatively rapid change, however, and current information should be checked for the exact list of countries at any specific time.

70. What effect will extending the low-frequency audio response of a signal have on the design of an SSB transmitter?

A. In a filter-type SSB exciter, extension of the low-frequency audio response requires redesign of the filter to have a wider passband, and may make carrier rejection more difficult. In a phasing exciter, achieving extended low-frequency response requires redesign of the audio phase shift networks, which are already a compromise. In either case, communications effectiveness is reduced, because the highest-power parts of the voice spectrum are in the frequencies below 300 Hz, while the parts producing intelligibility are above 300 Hz. Extending low-frequency response below 300 Hz thus limits the amount of power which can be devoted to the significant parts of the signal, while simultaneously making design and operation more difficult. For this reason most SSB rigs are restricted to 300–3000 Hz response.

71. List some different types of beam antennas.

A. Parasitic arrays, including the Yagi, the log-periodic, and as special cases the parabolic reflector and the corner reflector; Driven arrays, including the endfire, the Franklin collinear, the ZL Special, and the 8JK; and long-wire beams, including the rhombic, the vee-beam, and the simple long-wire. The term "beam antenna" includes all antennas having marked directional beam. Driven arrays can be composed of a number of parasitic arrays, and the elements of any driven array may themselves be complete driven arrays. Such complex beam systems are often used at VHF to achieve high power gain and extreme directionality.

72. What radioteletype transmitter operating deficiencies may be indicated by a decreasing antenna rf current during modulation of the final rf amplifier?

A. Decreasing antenna current during modulation, often called "downward modulation," may be due to several causes, depending upon the manner in which the modulation is applied. With conventional high-level plate modulation, downward modulation may be due to inadequate rf drive to the modulated stage, faulty tubes in the modulated stage, poor voltage regulation in the power supply (causing the modulator's power to be robbed from the modulated stage and thus causing a net loss in output), incorrect operating conditions in the modulated stage (particularly grid bias), or impedance mismatching between modulator and modulated stage.

With grid modulation the condition can arise as a result of attempting to get too much signal out at the carrier level, thus leaving room for upward modulation on peaks. This is improper adjustment of the loading. Lack of drive can also cause it, as can improper grid bias.

With screen modulation, downward modulation can result from improper loading, wrong grid bias, wrong screen voltage, inadequate drive, or insufficient modulator power. In all cases, the drive and loading conditions must permit the modulated stage to produce 4 times as much power at the

positive peaks of the modulating cycle as is produced at the carrier level, in order to achieve 100 percent modulation. If the stage is not capable of producing full output on positive peaks, downward modulation results because the indicated antenna current is the *average* over the modulating cycles, and with the peaks being clipped on the positive side, the negative peaks will reduce the average below the carrier level.

73. What improper operating conditions are indicated by the upward or downward fluctuation of a Class A amplifier's plate current when a signal voltage is applied to the grid? How can this be corrected?

A. Fluctuation of plate current when signal is applied to a supposedly Class A amplifier indicates only one thing: the amplifier is not actually operating Class A. This may be due to either of two possible causes: the input signal may be too large, driving the amplifier outside its intended operating range, or the grid bias is incorrect.

The remedy for overdrive is obvious – reduce the level of the input signal to that for which the stage is designed. Correcting improper bias is a bit more subtle.

If the plate current increases with signal, the stage has too great grid bias and it should be reduced. If the plate current decreases with signal, the bias is insufficient and should be increased. The correct bias is achieved when the plate current remains constant with application and removal of input signal.

At maximum drive and output, Class A power amplifiers show a slight increase in plate current as compared to the no-signal case, because of DC rectification in the output circuit. This should not be confused with the fluctuations referred to in this question.

74. What improper operating conditions are indicated by grid current flow in a Class A amplifier?

A. None, necessarily, because Class A amplifiers which depend upon grid current flow have been designed and operated. The conventional Class A amplifier, however, is designed to operate without grid current, and any grid current flow in such a circuit indicates overdrive. The chances are great that any such amplifier in which grid current is observed is not actually operating Class A because of the overdrive. See also question 73.

75. What may be the cause of a decrease in antenna current during modulation of a Class B rf amplifier?

A. The Class B rf amplifier should not be modulated directly; it operates properly only as a linear. If used as a linear, amplifying a signal to which modulation has been applied earlier, downward modulation indicates improper loading (too light) or an attempt to get excessive efficiency from the circuit. Downward modulation cannot occur with SSB.

76. What determines the skip distance of radio waves?

A. Skip distance depends upon two factors: the effective height of the reflecting layer, and the angle of reflection. These establish the altitude and one angle of a triangle, thus fixing the opposite leg's length (which is the skip distance). Both effective height and reflection angle in turn depend upon the frequency of the signal, and the condition of the ionosphere at the time.

77. How can parasitic oscillation be prevented?

A. By preventing the conditions (appreciable impedances at frequencies where the phase shift occurs) which permit them. This can be done by appropriate physical layout, choice of the proper types of bypass capacitors and rf inductors, and by application of parasitic suppressors to reduce gain at parasitic frequencies.

78. Give some proven methods of harmonic reduction in transmitters.

A. See question 61, Part III.

79. Describe briefly some well known types of antennas and antenna systems used by amateurs which do, and do not, reduce harmonic radiation.

A. Any non-resonant antenna will radiate energy at any frequency within the normal rf range equally well (or equally poorly). Thus it cannot reduce harmonics. Antennas which are themselves resonant, or which use resonant matching systems are selective and reduce at least some of the possible harmonics. Both types of antennas are widely used by amateurs.

One of the most well-known non-resonant antennas is the ordinary "long-wire" system. In its most common form, this consists of a length of wire of random length, insulated at one end and driven at the other. It is a common antenna for beginners' use because it is so simple to install. With luck, it can even be made to operate after a fashion. If the length is not some multiple of 1/4 wavelength at any specific operating frequency, the antenna is not resonant and so can radiate at any frequency. It therefore has virtually no reduction of harmonics.

The most common resonant antenna is the half-wave dipole. This consists of an electrical half-wavelength of wire, insulated at each end, split in the middle by an insulator, and driven in a balanced configuration at the center insulator ends of the two halves. It is resonant at every frequency for which the element halves are an odd multiple of 1/4 wavelength, and readily accepts power. Thus it will radiate at the 3rd, 5th, 7th, and other odd harmonics of the design frequency. It is also resonant at the frequencies for which the element halves are even multiples of 1/4 wavelength, but impedance at the feedpoint is inverted and it will not readily accept power from a low-impedance line. Thus it tends to reject energy at the 2nd, 4th, and all even harmonics of the design frequency.

Beam antennas achieve their directive qualities through careful phasing of the radiated energy, and this phasing is a function of frequency. Thus, most beam antennas reject all harmonics of their design frequency.

A popular class of ham antennas is the "all-wave" group which is designed to accept and radiate power at all ham frequencies using only one antenna system. Since the HF ham bands are all harmonically related, these antennas have had their harmonic-reduction properties carefully engineered OUT of them and consequently cannot adequately reject harmonics. Use of additional tuned circuits between transmitter and antenna system will restore selectivity and permit harmonic reduction.

80. What must the value of an inductor be to cancel a capacitive reactance of 12.6 kilohms at an operating frequency of 2 Mc/s?

A. The inductor must have inductive reactance of 12,600 ohms at the same 2 MHz frequency, so its value must be 0.001 H (henry), or 1 mH (millihenry).

81. What is meant by "end effects" in an antenna? How can they be compensated for in half-wave antennas?

A. The end effect in an antenna is an apparent lengthening of the antenna element. That is, its electrical length is slightly greater than would be expected from its physical length, because of capacitance at the end of the conductor.

In half-wave antennas, end effects are compensated by making the physical length of the wire approximately 5% less than the desired electrical length would indicate.

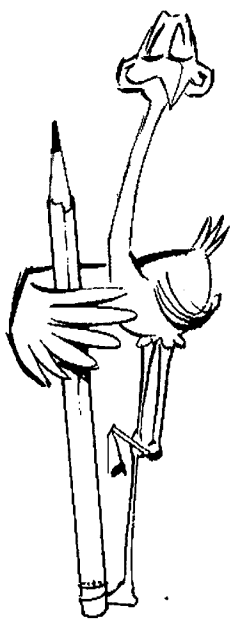
82. What are the bandwidths normally used for A1, A3 (single and double sideband), and F3 (narrowband) type emissions?

A. Bandwidth of A1 signals depends upon keying speed. Most A1 signals occupy less than 50 Hz bandwidth. A3 with both sidebands, whether or not carrier is suppressed, requires at least 6 kHz and often occupies as much as 30 kHz. A3 with single sideband takes 3 kHz with carrier, and 2.7 kHz without. F3 in HF ham usage cannot exceed 6 kHz; at VHF it is not limited.

83. Describe briefly how an ac power supply produces a dc output voltage. Discuss the merits of using choke-input versus capacitor-input filters in power supplies. How does the leakage resistance of the capacitors affect the output voltage? Also, what is voltage regulation as related to power supplies?

A. The power supply uses a suitable transformer to convert the input ac to the appropriate voltage level, followed by a rectifier circuit which converts the ac to pulsating dc. Finally, a filter circuit smooths out the pulsations, yielding an approximation to "pure dc" as output. The quality of the approximation depends upon the quality of the filter.

A choke-input filter provides better voltage regulation than does the capacitor-input filter, but produces lower output voltage under light load conditions. The



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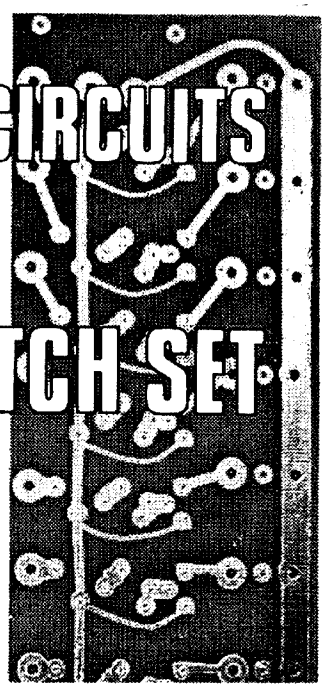
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capacitor-input filter produces higher output voltage, but puts more strain upon the preceding components in the power supply. In consequence choke-input filters are normally used where high power is required, and capacitor-input filters are restricted to applications requiring comparatively low power (receivers and test equipment).

If a filter capacitor develops excessive leakage, (abnormally low leakage resistance), it will act as an additional load on the power supply thus reducing output voltage. It will also degrade filter performance. In most cases, such a situation is self-destructive; the abnormal current through the capacitor results in overheating, further weakening the capacitor, and the capacitor fails shortly.

Voltage regulation is a measure of the change in power supply output voltage between the no-load and fully loaded conditions, usually expressed as a percentage. The precise definition of voltage regulation varies, depending upon the reference book consulted. Thus a power supply which produces 105V dc at no load and drops to 95V dc at full load may have a voltage regulation of 95/105 (99.5%), 10/105 (9.5%), or 10/95 (10.5%), depending upon the definition used.

84. Compare silicon and vacuum tube diodes. What is meant by the "forward voltage drop" of a conducting silicon diode?

A. The silicon diode is a semiconductor device which operates upon the junction principle, while the vacuum tube diode operates upon the principle of thermionic emission. Thus most vacuum tube diodes require that the cathode be heated, while silicon diodes do not. Silicon diodes can conduct much greater current per cubic inch, but are far more subject to damage by improper operating conditions such as excessive reverse voltage or overheating.

Any diode is characterized by a "forward voltage drop." In a tube, this is the operating voltage required to move electrons across the cathode-to-plate distance, and ranges from 5 to 15 volts in most cases. In a silicon diode, it is the energy-level barrier between operating energy levels at the atomic level, and is approximately 0.65 volts (germanium diodes have a barrier of approximately 0.25 volts). The voltage drop is subtracted from the

applied voltage; if 5V dc are applied to a silicon diode, 4.35V dc will appear at the output.

85. What is push-pull amplifier operation?

A. Push-pull amplifier operation is a circuit arrangement in which a single stage contains two identical amplifiers, which are driven by input signals which are 180 degrees out of phase with each other. Outputs are similarly 180 degrees out of phase. If balanced input and output are available, no phase-inverting components are necessary. If input and/or output is to be unbalanced (single-headed), phase inversion is required. One of the simplest phase-inverting components is a transformer with a center-tapped winding. The center tap is the common return, and out-of-phase signals are either taken from or applied to the opposite ends of that winding. The other winding will combine the energy of both halves of the first, producing an unbalanced signal as required.

The push-pull or balanced circuit cancels out most even-order harmonics. It is widely used in industrial electronics under the name "differential amplifier" because any signal which is in the same phase at the inputs of both sides is cancelled out of the output.

86. For what purpose is a Q-multiplier used in amateur equipment? What major factors affect the Q of a coil? Of a circuit?

A. The Q-multiplier is usually used to increase the selectivity of a tuned circuit in a receiver; it may also be used to reject a specific signal frequency.

The Q of a coil is determined by the ratio of energy stored in the coil's magnetic field to energy dissipated in the coil's conductor, or the ratio of reactance to resistance. Thus size, material, and proximity to other components affect it.

The Q of a circuit is determined by the individual Q's of the circuit components, and again is defined as the ratio of energy stored to energy lost. Anything which causes loss of energy reduces the circuit Q; anything which increases its energy-storage capacity without increasing the energy loss will increase the Q.

87. How can the final amplifier of a transmitter be tested for self-oscillation?

A. See question 53, Part III.

88. How does a frequency converter operate?

A. Whenever two ac signals are simultaneously applied to a non-linear circuit, four ac signals are produced: the two original signals, a third signal having the frequency equal to the sum of the frequencies of the two original signals and the amplitude characteristics equal to the sum of the amplitudes of the two originals at each instant, and a fourth signal whose frequency is the difference of the original frequencies, also having amplitude determined by the instantaneous sum of the amplitudes of the originals. This action is known as mixing, modulation, demodulation, detection, or frequency conversion, depending upon what part of the communication chain contains it.

A frequency converter accepts an input signal at one frequency and converts it to an output signal at some different frequency by mixing it in a non-linear circuit with a local signal of constant amplitude. Since the local signal's amplitude is constant, the output signal's amplitude characteristics follow those of the input signal exactly. Output signal frequency is determined by the local signal frequency. Either the sum or the difference signal may be used for output. Tuned circuits eliminate the three unwanted signals from the output.

89. What visual observation within an operating vacuum tube's envelope would indicate that the tube is gaseous?

A. An intense blue glow in the space between plate and cathode of the tube, during operation, would indicate that the tube is gassy. A "gaseous" tube would be somewhat difficult to identify, being neither solid nor liquid (those being the three states in which matter can exist at normal temperatures); the ability to pass one's hand through it might be a valid indication of its being gaseous!

Questions based on Part 97 of the Commission's rules.

A. Obtain a copy of Part 97 and study it well, taking care to be familiar with those provisions which specify frequency bands and sub-bands, types of modulation, technical requirements, power limits, and administrative details such as license term, display of license, etc. . . . Staff

Richard W. Fergus W9DTW
2N570 Argyle Street
Lombard IL 60148

THE INDESTRUCTIBLE (BUT SENSITIVE) VOLTMETER

One piece of test equipment found in many hamshacks is the voltmeter. There are many voltmeter variations and each variation has advantages and disadvantages. Many of us have an idea of what we would like for the "perfect" voltmeter. Over the years, I have thought about my ideal voltmeter but never applied the elbow grease. Recently, the urge became strong and I actually built it. I can best describe my ideal voltmeter by describing the result of this urge. The voltmeter features a zero-center meter with a sensitivity of 1.33 MΩ/V for the 0.25–25V full-scale ranges. The input resistance is a constant 33.3 MΩ for the 25–750V ranges. Two current ranges of 0.75 and 7.5 μA were also included. The voltmeter can withstand most conceivable overloads without the slightest damage.

Theory

High input resistance is one very desirable characteristic of a voltmeter. Most panel meters are much too insensitive to provide the high input resistance; therefore, some kind of amplifier must be used. The common vacuum-tube voltmeter or transistor voltmeter, with which many of you are familiar, generally use the input–output or transfer characteristic of a tube or transistor to provide the amplification. The accuracy is affected by the inherent instability and nonlinearity of the tube or transistor as well as by power supply fluctuations. There is another way to obtain the required amplification without these problems. The technique (negative feedback) is not new and is used extensively in industrial instrumentation and analog computers.

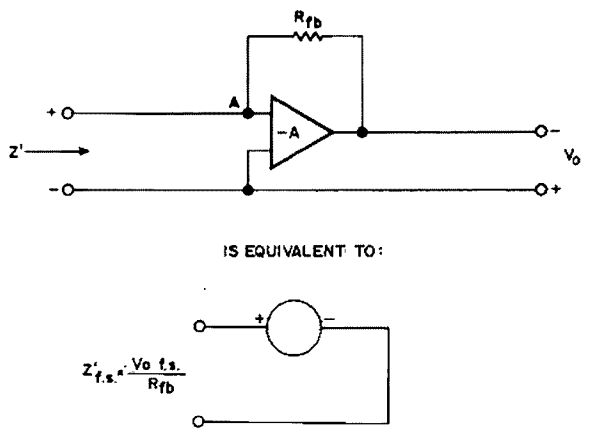


Fig. 1. Feedback amplifier equivalent circuit.

Negative feedback is used in many applications to reduce distortion and, in general, provide stable amplification. If sufficient feedback is used, such factors as transistor (or tube) variations and power supply instabilities have negligible effect on the overall gain of the amplifier. This type of circuitry is more complicated and, therefore, more expensive. In the past, the additional expense has eliminated this technique from the lower priced instruments and ham designs. Now, with the availability of good quality

economical transistors, all of us can afford this "sophisticated" technique.

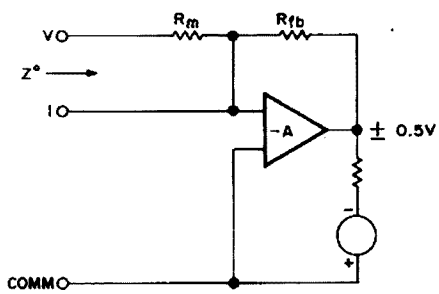
One way to explain this technique is to think of the amplifier in Fig. 1 as a balancing device. If the amplifier has very high gain, a small voltage at the summing point (A) will appear at the amplifier output as a large voltage. Since the amplifier gain is negative (that is, a positive input produces a negative output and vice versa) the current through R_{fb} will oppose the input current. The opposing current will tend to drive the summing point back to zero voltage. In other words, the amplifier output opposes the input current until a balance or zero voltage is approached at point A. This balancing action will produce a current through R_{fb} which is very nearly equal to the input current. Even though summing point A is not directly connected to ground, the action of the feedback will maintain the voltage near zero. A more technical term for this point is a "virtual ground;" it appears like a ground point but actually isn't.

If the input voltage is always near zero voltage and the current through R_{fb} is equal to the input current, the output voltage (with reference to actual ground) is proportional to the input current. Applying Ohm's law, input current will be equal to the output voltage divided by the feedback resistance.

The advantages may not be apparent yet, but if we consider that the amplifier input can be a very, very small current, then the current through R_{fb} can also be very small. While the amplifier is balancing out this small current through R_{fb}, it can also supply a much larger current for the output voltmeter. The amplifier, feedback resistance, and output voltmeter can now be thought of as a sensitive current meter.

Without going into detail, a simplified example will demonstrate how feedback can reduce the effect of amplifier gain change on the overall circuit performance. If we assume an amplifier gain of 100 and output voltage of 1V, the amplifier input voltage will be −0.01V (remember the amplifier gain is negative). The actual voltage across R_{fb} will be 1.01V. Now, let the amplifier reduce gain by 50% or to a gain of 50. With this condition, the input voltage will be −0.02V when the output is 1.0V. Now the actual voltage across R_{fb} will be 1.02V. The voltage change across R_{fb} between the two conditions will be 0.01V or slightly less than 1% (0.01/1.01) change. Thus, a 50% change in amplifier gain produced only about 1% change in feedback current. Since all such things as instabilities, nonlinearities, and power supply variations are reflected in amplifier gain, the effect of these factors on the overall performance is reduced.

To sum up, the amplifier, feedback resis-



RANGE (VOLTS)	Z (μA)	Rm (ohms)	Rf (ohms)
±0.25	±0.75	333K	667K
0.75	"	1.00M	"
2.50	"	3.33M	"
7.50	"	10.0M	"
25.0	"	33.3M	"
75.0	2.25	"	222K
250	7.50	"	66.7K
750	22.5	"	22.2K

RANGE RESISTOR CALCULATION

Fig. 2. Range resistor calculation.

tance, and output voltmeter can be thought of as a sensitive current meter. The sensitivity, accuracy, and linearity is a function of the output voltmeter and feedback resistance and is relatively independent of amplifier variations. For the remainder of the voltmeter design, this combination can be replaced with an equivalent current meter. The input current sensitivity will be equal to the full scale output voltage divided by the feedback resistance.

Two methods are used to provide voltmeter ranges from 0.25 to 750V. As you will see, other ranges are easily calculated. For purpose of calculation of feedback resistors (R_{fb}), the voltmeter circuitry can be simplified as illustrated in Fig. 2. On the lower ranges, the current sensitivity is constant and the multiplier resistor (R_m) is changed with the range switch. The output voltage is the

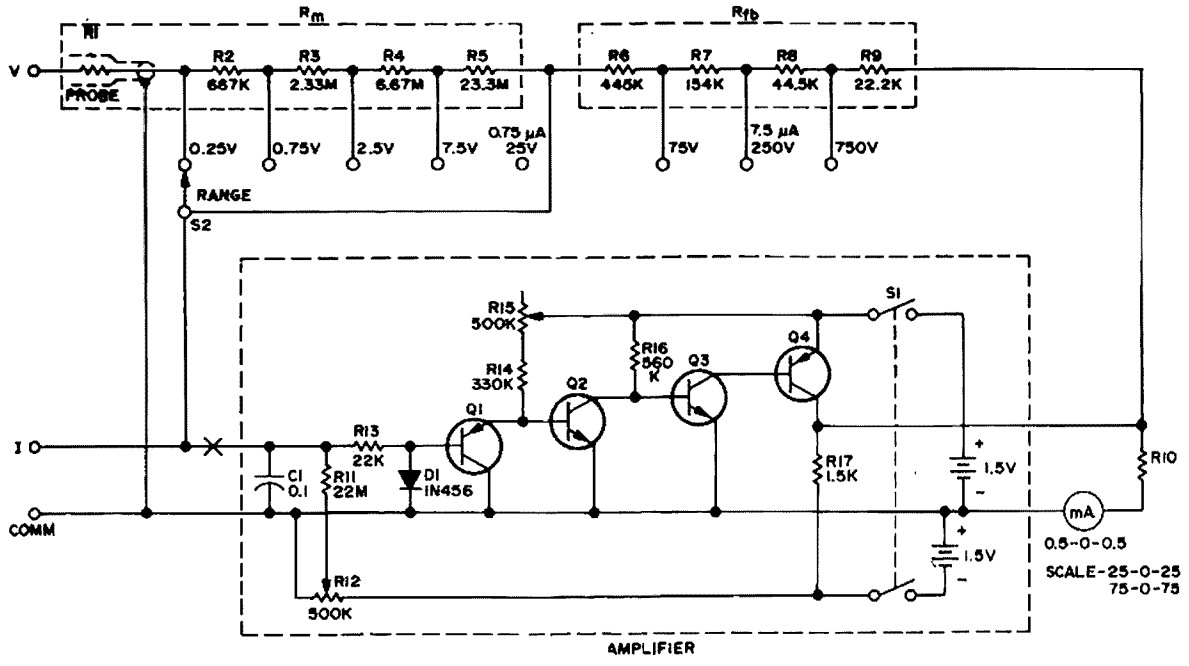


Fig. 3. Schematic.

same for all ranges. The output voltage swing determines the series resistance for the milliammeter. Full scale current for the lower ranges was selected at 0.75 μA. The feedback resistance, which also will be constant for the lower ranges, is equal to the full scale output voltage divided by the full scale current, or 0.5V divided by 0.75 μA. With this resistance (667 KΩ), we now have an input current sensitivity of 0.75 μA full scale. The multiplier resistances are calculated as if we had an 0.75 microammeter. For the 0.25V range, the resistance will be equal to 0.25 divided by .00000075 or 333,000Ω. The ranges up to and including the 25V range are calculated the same way.

For the higher ranges, the multiplier resistance is held constant and the current sensitivity is changed by selecting the feedback resistance. The multiplier resistance (33.3 MΩ) for the 25V range becomes the constant multiplier resistance for the higher ranges. As an example, on the 750V range the input current will be 22.5 μA (750/33,300,000). A new value feedback resistance must be calculated to provide this current sensitivity. With the same 0.5V output voltage, the feedback resistance will be 22.2 KΩ. All resistances values and the equivalent circuit are shown in Fig. 2.

Either method could be used for all ranges, but this combination was chosen as a compromise to maintain low input current on the lower ranges without requiring extremely large – and expensive – resistance values on the high ranges. Either procedure can be used to calculate feedback and multiplier resistances for other ranges. The feedback current should be selected within the amplifier design range of 0.75 to 50 μA.

A current function is also available as an added feature. For the particular ranges selected, only two ranges agree with the meter scales. The other ranges would be 2.25 and 22.5 μA, which can also be used, with a few mental gymnastics, to convert from one of the scales.

The voltage drop across the input used as

PARTS LIST

Component	Description	Suggestions
B1, B2	1.5V battery	Any size
C1	0.1 μF	Mylar or paper – any voltage rating
CR1	1N456, 1N4148	Low leakage silicon diode
M1	500-0-500 Microammeter	Simpson Model 1329 43Ω resistance Newark 55F2518
Q1, Q4	2N3906, 3N3702	Low leakage, low current silicon PNP transistor
Q2, Q3	2N3904, 2N2925	Low leakage, low current silicon NPN transistor
R1	333K 1%	332K R1 thru R10
R2	667K 1%	665K Texas Inst. Type CD 1/2 MR
R3	2.33M 1%	2.32M Newark 12F080 (spec. value)
R4	6.67M 1%	6.65M
R5	23.3M 1%	7.87M + 7.87M + 7.50M
R6	445K 1%	442K
R7	154K 1%	154K
R8	44.5K 1%	44.2K
R9	22.2K 1%	22.1K
R10	957 1%	953 See text
R11	22M 10% ½W	
R12, R15	500K trimpot	Mallory 55L1 Newark 60F2210
R13	22K 10% ½W	
R14	330K 10% ½W	
R16	560K 10% ½W	
R17	1.5K 10% ½W	
S1	D.P.S.T.	Optional
S2	Single pole 8 ps. rotary.	Centralab type PA2001 Newark 22F601

a current meter is very low. Since the amplifier gain determines how near zero the summing point is maintained, it also determines the voltage drop when the circuitry is used as a current meter. The amplifier voltage gain is about 100; therefore, when the meter indicates full scale (0.5V), the input voltage will be about 0.005V. Most milliammeters or microammeters will have 0.05–0.20V drop at full scale.

Circuit Description

Four direct-coupled silicon transistors form the amplifier portion of the voltmeter. The first two stages are operated at low collector voltage and current. In both cases, the base-to-emitter voltage (about 0.6V) of the following stage is also the collector-to-emitter voltage of the driving stage. This type of connection may appear strange, but it is a very legitimate application of silicon transistors. The last two stages are connected in a more conventional manner. This amplifier layout provides high current gain with a minimum of components.

The first two stages are operated at nearly equal collector currents and connected so that the base-to-emitter drops will cancel. The NPN (Q2) base voltage will be about +0.6V. When we connect a PNP (Q1) to this base, the PNP (negative) base-to-emitter voltage will tend to cancel the positive voltage of the NPN transistor. Actually, by adjusting the collector current ratio of the two transistors, the two base-to-emitter voltages can be made to cancel exactly. Similar reasoning will show that the temperature coefficient of the base-to-emitter voltages will also tend to cancel. The temperature coefficient defines the change in base-to-emitter voltage with temperature. This coefficient is the prime cause of instability in transistor dc amplifiers and is a cource of operating-point change in ac amplifiers.

The interconnection between the first two stages is also a current summing point or virtual signal ground. The current through R14 must divide and flow through either Q1 emitter or Q2 base. Therefore, any Q1 emitter current change will become a base-current change for Q2. The voltage at this point will *not* change. A similar situation occurs between the Q2 collector and Q3 base. Since Q3 collector is connected to Q4 base, it is obvious that the Q3 collector current changes are passed on to Q4. The result is an overall current gain of the amplifier which is the product of the current gains of the transistors. Even with the first two transistors operating at a low current gain (result of low collector current and voltage), the overall amplifier current gain is greater than 100,000.

The input offset current (current required for zero output voltage) is supplied by R11. The offset current adjustment is similar to biasing a single transistor, except in this case we are "biasing" a complete amplifier. An adjustment is shown in the schematic but the adjustment is not critical and fixed resistances could be used. When the amplifier is operating in closed loop (with the feedback connected) some offset current can be supplied through the feedback resistance without noticeable effect on the voltmeter performance.

Overload protection is supplied by R13, CR1, and the base-to-collector junction of Q1. As explained, the amplifier input is at zero potential during normal operation. If overloads are applied, the amplifier may saturate and not supply sufficient feedback current. Since the feedback current normally maintains the zero input voltage, loss of the feedback current will allow the summing point to stray from zero. If allowed to increase without limit, the input transistor could be damaged. The solution is to provide some current limiting (R13) and clamp the amplifier input with diodes. The positive excursions are clamped with CR1 and the negative excursions by the base-to-collector junction of Q1.

Meter current is also limited to a safe value by resistors R10 and R17. The output transistor (Q4) will either be cut off (positive input) or saturated (negative input) during overload situations. Maximum meter current is therefore limited to about 1.5 mA on negative inputs and 0.6 mA on positive inputs. Neither value will damage the meter movement.

The circuit is most susceptible to overloads when used in the current function. A couple of quick calculations will demonstrate the protection provided. Both the clamping diode (CR1) and the base-to-collec-

tor junction of Q1 will pass 100 mA for short periods without damage. As long as the diodes function, the amplifier and meter will be protected. Since the input current is limited by R13, the input voltage would be 2.2 kV with a diode current of 100 mA. The R13 wattage rating limits continuous overloads to about 100V.

When the voltmeter function is used, higher overload voltages are easily accommodated. On the 0.25V range, the total series resistance is 355 KΩ. Now the half-watt resistor rating limits the continuous overload to about 350V and the diode current will protect up to "3.5 kilovolts" – hardly conceivable!

Higher-wattage resistances could be used but most of us would not subject the voltmeter to continuous overloads. The worst that could happen from a continuous overload would be to burn up either R1 or R13. I don't think it is possible to damage a transistor or the meter with conceivable overloads. By the way, one point to think about – how many 0.75 μA meters are protected from continuous overloads up to 5 mA and terminal voltages of 100V? How many 0.25V meters are protected against 350V continuous or momentary kilovolts?

The feedback network completes the voltmeter circuitry. For any one range only two resistance values are required. The capacitor (C1) provides high-frequency attenuation to prevent amplifier oscillation. The range switching is not quite conventional. A single-pole switch is used to select the proper multiplier and feedback resistance. The switch actually shorts out the unused portion of the resistance string.

Construction

The layout is not critical and is left up to the builder. Standard solid-state construction methods must be used – watch the heat when soldering! The ranges selected may seem strange but fit very nicely with a standard 50-division meter scale. The meter I used was a 1.0 mA unit I readjusted to a 500-0-500 μA span. I removed the numbers on the original face with an eraser, leaving the scale markings. The new numbers were hand-lettered on the face. On the 50-division scale, the selected ranges require one unit per minor division on the 25-0-25 scale, with 5, 10, 15, 20 and 25 at major division. The second scale requires 3 units per minor division with 15, 30, 45, 60 and 75 at the major divisions.

Feedback and multiplier resistances (R1–R9) must be accurate if the precision of the voltmeter is to be maintained. I selected resistances from carbon resistor stock using a Heathkit impedance bridge. The builder who does not have access to measuring equipment can buy 1% precision resistors from a parts house. I believe it is possible to buy 1% resistors, a 2% panel meter, and assemble this voltmeter with 3% or better error without further calibration. This demonstrates the beauty of the feedback amplifier – final accuracy is only dependent on the resistors and meter used.

The voltage probe is constructed of shielded cable with one multiplier resistor (R1) mounted in the tip. The shielding reduces ac pickup which might cause nonlinear operation of the amplifier, and the tip-mounted resistor reduces capacity loading of the circuit under test.

All components are described in the parts list. Most of the components are not critical as long as the noted characteristics are met. The transistors are not critical with regard to voltage rating or frequency response but must have low leakage and some current gain at low current (around 3 μA collector current). The transistors specified have been used successfully, although many other types are available which should be satisfactory. The suggested precision resistor series is the most economical that could be found which is readily available.

The final performance of the voltmeter can be no better than the quality of the meter. A quality movement can be used to advantage if the wallet can afford it. Some of the new taut-band meters which are very rugged would be a good choice. Other movement sensitivities can be used with some circuit modification. First, the scale divisions must be considered. The ranges in this voltmeter are based on a 50-division scale. Other scales will require some rearrangement of the ranges. One rule to follow when selecting ranges and scales is: Minor divisions should always represent

whole numbers (a minor division should represent either 1, 2, 3, etc., but not 1.5, 1.33, or other noninteger values). One exception to this can be 2.5, which sometimes works out reasonably well. As a last resort, you can always draw a second scale along the original scale.

A different meter sensitivity also requires different meter resistors (R10) and load resistor (R17). The amplifier output is ±0.5V full scale, so R10 must be chosen to make the selected meter read (with the resistor in series) 0.5V full scale. This calibration can be either calculated (if the meter resistance and sensitivity is known) or a portion of the series resistance can be replaced with a Trimpot. After the meter is completed, the voltmeter can be calibrated to a known voltage with the Trimpot adjustment. Following this procedure for the described voltmeter, R10 should be replaced with an 887Ω 1% resistor and a 100Ω Trimpot (assuming the meter resistance is less than 100Ω). This procedure is also better for the perfectionist who would like to get the most accuracy from his voltmeter.

The load resistor (R17) which also determines battery current should be changed to agree with the meter sensitivity. It should be 1.5 times the total resistance of the meter and the series resistor (R10). With a little investigation, you will find that the battery current, with no input to the voltmeter, will be twice the full-scale meter sensitivity. With the described voltmeter, the battery current will be about 1.0 mA. If a more sensitive meter is used, the battery can be reduced proportionately. As an example, if a 50-0-50 μA meter is used, the battery current would be 100 μA and two RM1 mercury cells (1000 mA-hr) would last for about 10,000 hours, or one year of continuous operation. With this meter sensitivity, R17 would be 15 KΩ and R10 plus the meter resistance would be 10 KΩ.

The described voltmeter should operate continuously for about 6 months with two size D flashlight batteries. Therefore, the off-on switch is optional, depending on how often you would like to change batteries. Even with small batteries, the voltmeter can be left on occasionally without running the batteries down.

Checkout

Do not connect the range switch to the amplifier as indicated by the X on the schematic. Now, with the power applied and R12 adjusted for zero voltage on the arm, the meter should be pegged. Slowly adjust R12 and the meter should swing down-scale. Try to adjust for an on-scale meter reading. It isn't necessary to be very accurate since the amplifier feedback will take care of considerable misadjustment. If the meter doesn't swing down-scale, R11 can be decreased to about 5 MΩ or a different transistor tried for Q1.

To adjust the voltage offset, short the amplifier side of X to ground. Adjust R15 for a midscale meter reading (within 5 divisions of zero). Again, it isn't necessary to be very accurate. This completes the initial adjustment of the voltmeter. The wiring can be completed by connecting the range switch. The voltmeter is now operational. If a Trimpot was added to the meter resistance (R10), now is the time to apply a known voltage to the input and adjust the pot for the correct meter reading. These adjustments should not change in the future. I actually selected fixed resistances for my voltmeter and no change has been apparent in over a year of operation. *Do not* attempt to readjust R12 and R15 with the switch connected. The effect of these adjustments is not very noticeable except under detailed examination.

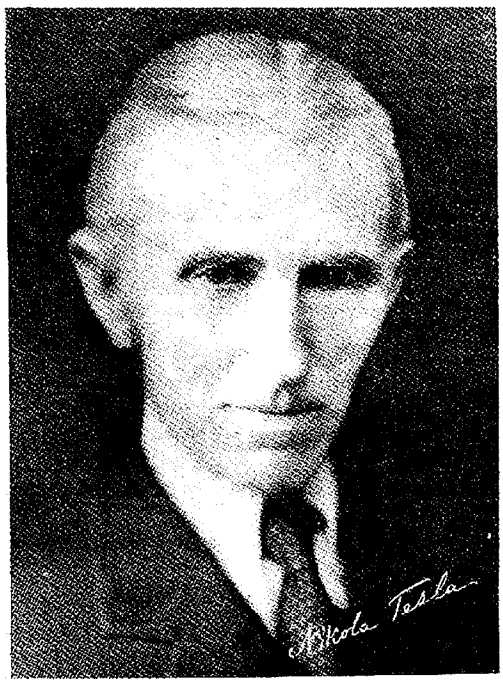
Conclusion

Several voltmeters have been built with good results. One model was subjected to temperature stability tests from −20 to +140°F with less than 2% of full-scale drift in calibration and zero reading. The basic circuit has also been used for a dc oscilloscope amplifier.

The feedback and instrumentation techniques that have been presented are also useful in other ham applications. This circuit can be used for other sensitive current measurements in conjunction with field strength meters and swr bridges. Other applications will become more apparent as the circuit capabilities are better understood.

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Commander E. J. Quinby, USN (Ret.)



WHO WAS TESLA?

Ask any electrical engineering student today to tell you something about Tesla, and you are likely to get a blank stare. Or the counter-question: "Who *was* Tesla?" It seems preposterous that our educators should have ignored entirely the founder of our ac age, but such is the fact. Something should be done about our technical education system.

Born July 9, 1856 in the village of Smiljan in what is now Yugoslavia, Tesla rose from relative obscurity to a top position in the scientific world. He became a millionaire at 32 through his important inventions, only to fade later into obscurity, and died penniless.

His father was a clergyman. His mother, though she never learned to read and write, was known in the community as an inventor of domestic labor-saving devices, and it is to her that Tesla attributed much of his inventive genius. The young Tesla, opposing his father's urging to study for the ministry, insisted on a career in engineering. His mother encouraged him. He attended the polytechnic school at Graz, specializing in physics and mathematics, and continued his education at the University of Prague. There he took a course in foreign languages, so that he could read the foreign technical literature. He became proficient in English, French and Italian, in addition to the German with which he was already familiar, and of course, his native Serbian.

Finishing at Prague in 1880, he took a post-graduate course in Budapest, where he debated the merits of alternating current with his professors. He then went to work for a Paris telephone company, where he acquired considerable experience with dc dynamos and motors. While there he invented regulating and control devices to protect the rotating machines he served.

Electrical Industry Was Limited

In those early days, direct current was universally acknowledged to be the only practical medium for generating, transmitting and applying electricity for heat, light or power. But dc resistance losses were so great that a power plant was needed for every square mile served. Early incandescent

lamps, glowing none too bright on 110 volts even close to the power plant, became pitifully dim on the power that dribbled from the lines less than a mile away. And everyone believed that motors could run only on dc. An alternating current motor was considered an impossibility.

This was the picture when, in 1884, young Tesla stepped off a ship in New York, his head full of ideas, and four cents in his pocket. His experience had convinced him that the commutator in direct current motors and dynamos was an unnecessary complication, causing endless troubles. He realized that the "dc generator" actually produced ac, which was rectified by the commutator into a series of waves, all flowing in the same direction through the external circuit.

Then, to get this dc to produce rotary motion in a motor, the process had to be reversed. The armature of each electric motor was equipped with a rotating switch (commutator) that changed the polarity of its magnetic poles just at the right instant as it revolved, to supply ac to the motor.

The Inspiration

To Tesla, this was sheer nonsense. It seemed logical to eliminate the commutator at both generator and motor, and use ac through the whole system. But no one had ever built a motor that could operate on alternating current, and Tesla struggled mentally with the problem. And one day in February, 1882, while strolling with a classmate named Szigetti in a Budapest park, he suddenly blurted out: "I've got it! Now watch me reverse it!" At that moment he had visualized the rotating magnetic field, which would revolutionize the whole electrical industry. He saw the magnetic pull racing around the stationary field (stator) of his motor while the armature (rotor), attracted by the moving field, chased around after it faster and faster until it was revolving at the same rate. He would need no switching to the rotating element – no commutator!

Subsequently he worked the whole alternating current electrical system out in his mind – including alternators, step-up and step-down transformers for economical transmission and delivery of electric power, and ac motors to supply mechanical power. Impressed by the wealth of available water power going to waste around the world, he visualized the harnessing of this great supply with hydro-electric plants capable of distributing the power to where it was needed. He startled fellow-students in Budapest by announcing: "Some day I will harness Niagara Falls."

Discouraged by Edison

The opportunity and fortune Tesla sought in the promised land did not come easy. When he met Edison, then actively engaged in developing a market for his incandescent lamp through his pioneer Pearl Street plant in New York, Tesla launched with youthful enthusiasm into a description of his alternating current system. "You are wasting your time on that theory," the great man told him, dismissing the idea promptly and finally.

For a year, the tall, gaunt Yugoslav struggled to keep from starving in this strange land. At one point he dug ditches to make a living. But the foreman of the Western Union ditch-digging project on which he was working listened to the visionary descriptions of new electrical systems that Tesla related during lunch hours, and introduced him to a company executive named A. K. Brown. Fascinated by Tesla's vivid plans, Brown and an associate decided to take a flyer. They put up a limited amount of money, with which Tesla set up an experimental laboratory at 33-35 South Fifth Avenue (now West Broadway). There Tesla set up a complete demonstration of his system, including generator, transformers, transmission line, motors and lights. He worked tirelessly, and without drawings; the plans for every detail were indelibly etched in his mind. He even included two-phase and three-phase systems.

Professor W. A. Anthony of Cornell University examined the new ac system, and promptly announced that Tesla's synchronous motor was equal in efficiency to the best dc motors.

Alternating Current Arrives

Tesla then attempted to patent his system under a single comprehensive patent cover-

ing all its components. The Patent Office would not approve the all-in-one application, insisting on separate applications for each important idea. Tesla's applications, filed in November and December of 1887, resulted in the granting of seven U.S. patents in the next six months. In April, 1888, he filed for four more patents, covering his polyphase system. These too were promptly granted, as were 18 more U.S. patents later in the year. These were followed by numerous European patents. Such an avalanche of patents, so promptly issued, was without precedent, but so completely novel were the ideas -- so completely absent was any element of interference or "anticipation" – that the patents were issued without a single challenge.

Meanwhile Tesla staged a spectacular lecture and demonstration of his ac system – single phase and polyphase – at a meeting of the AIEE (now the IEEE) in New York. The engineers of the world were made aware that the limitations on electric power transmission by wire had been removed, opening the door to tremendous expansion.

But who would adopt this obviously better system? Certainly not the established Edison-General Electric organization – it would have made their whole investment obsolete. Apparently Tesla was stuck – with no market, no customer for what he had to offer.

It was at this moment that George Westinghouse walked into Tesla's laboratory and introduced himself. Tesla was then 32 years old, Westinghouse 42. Both were capable inventors, accomplished engineers and electrical enthusiasts. Westinghouse listened to Tesla's explanations watched his demonstration, and quickly made up his mind.

"I will give you one million dollars cash for your alternating current patents, plus royalties," offered Westinghouse.

"Make that royalty one dollar per horsepower, and it's a deal," replied Tesla, without apparent excitement.

As simply as that, the two men arranged the historic deal and shook hands on it.

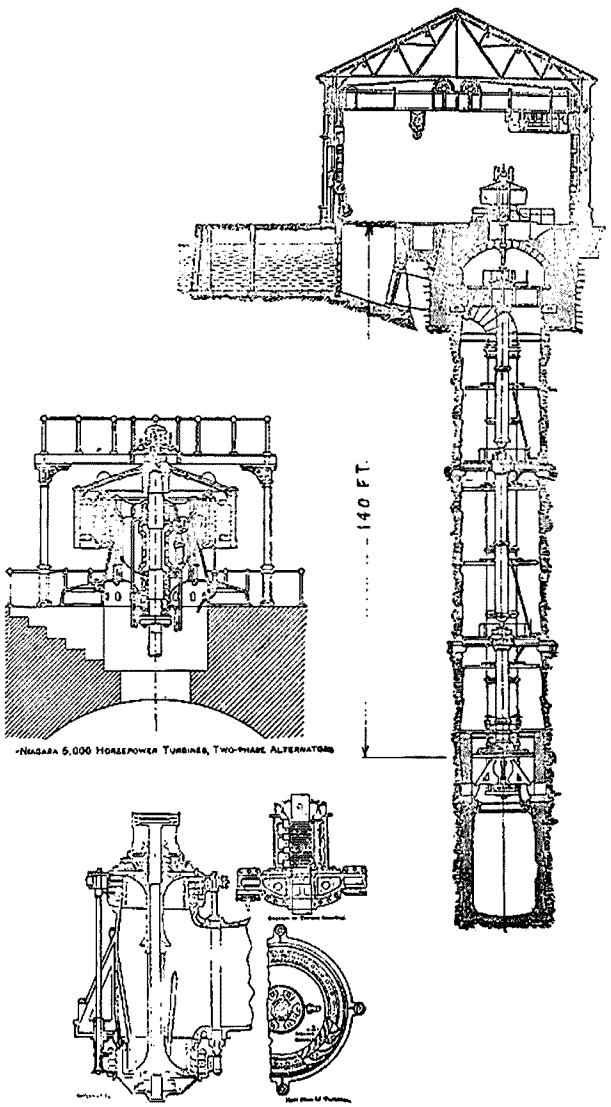
Tesla had arrived! But he was not a man to forget those who had placed their faith in his ideas, and promptly signed over his million-dollar fee to Brown and his associate, who had financed his laboratory. Although the backers of Westinghouse later forced him to get a release from Tesla on the dollar-per-horsepower part of the agreement, such was the friendship that had developed between the two men that an amicable settlement was quickly reached. Tesla relinquished the royalties that would have supported him and his research efforts for the rest of his life.

The phenomenal success of the Westinghouse ac systems across the nation made it clear to General Electric engineers that they would have to get a license from Westinghouse if they were to keep up in the rapidly expanding electrical industry. The license negotiated at a handsome fee – was a feather in Tesla's cap; he distinctly recalled Edison's statement that there was no future in alternating current and that experimenting with it would be a waste of time.

A Dream Realized

In 1890, the International Niagara Commission began trying to determine the best way of using the power of Niagara Falls to generate electricity. The scientist Lord Kelvin was appointed chairman of the Commission – and he immediately announced that a dc system would obviously be best! It was not easy to challenge this world-famous authority, but he eventually came to realize that if power were to be transmitted even the 26 miles to Buffalo, ac would be necessary. So it was finally decided to use Tesla's system and generate ac with massive water turbines. Bids were invited by the newly formed Cataract Construction Co. in 1892. Westinghouse won the contract for the ten 5,000-HP hydro-electric generators, and General Electric the contract for the transmission system. The whole system – the line, step-up and step-down transformers all followed Tesla's two-phase design. He designed the big alternators with external revolving fields and internal stationary armatures, to minimize the weight of the moving members.

This historic project created a sensation, for nothing of this magnitude had been



One of the 5,000 h.p. Niagara Falls units, with detail at left. Upper drawing shows the hollow drive shaft that goes through the stationary armature to rotate the field, which hangs outside and around the armature.

attempted at the time. The ten big 2,250-volt alternators, revolving at 250 rpm and delivering 1,775 amperes each, produced an output of 50,000 HP or 37,000 kW, 25 Hz, two-phase. The rotors were 10 feet in diameter and 14 feet long (14 feet high in these vertical generators) and weighed 34 tons each. The stationary members weighed 50 tons each. The voltage was stepped up to 22,000 for transmission.

Remote Radio Control

Tesla's pioneering in the realm of radio ("wireless" as it was then called) went further than Morse code communication. In 1898 he staged a spectacular demonstration of remote control without wires at the original Madison Square Garden, New York City. The first annual Electrical Exhibition was then in progress, and in the center of the vast area where Barnum & Bailey's circus usually performed, he had a large tank constructed and filled with water. Afloat on this small lake he had a 3-foot-long iron-hulled boat, with its mast supporting an antenna. Inside the hull was a radio receiver and an assortment of electric motors, driven by storage battery, to perform various "ship" functions.

From the opposite end of the auditorium, Tesla put the vessel through a variety of maneuvers, including sailing forward, steering left and right, stopping, reversing, and lighting the lights in its rigging in response to audience requests. The impressive demonstration of course "stole the show" and made the front page of the daily newspapers. But how many dreamed that one day, using these radio-remote-servo-control principles, we would land some of our citizens on the moon?

Mathematical Wizardry.

Tesla's mathematical genius stood him in good stead in the design of the items of ac equipment that Westinghouse and GE undertook to manufacture. (In his early student days, he solved complex problems in his head, without pencil and paper). His teachers suspected him of cheating, and put him to conclusive tests. Young Telsa, it developed, had memorized whole logarithmic tables!) The now established frequency of 60 cycles per second (Hz) stems from Tesla's mental calculations, which convinced him that it was the most practical frequency for commercial use. At higher frequencies, ac motors would become inefficient; at lower frequencies they would require too much iron. Lights would also flicker at low frequencies.

Though the original Niagara Falls plant was designed for 25 Hz to accomodate the limitations of the early Westinghouse turbine generators, subsequent expansion included conversion to 60 Hz. Today this Niagara power is transmitted all the way to New York City, 360 miles away, and at times is fed over the Northeast power grid for much greater distances. (When Tesla arrived in

New York, the limit for efficient power transmission was less than a mile!)

High Frequency Pioneering

During his investigations into the unknown realms of high voltage and high frequency, Tesla adopted a most sensible practice. When handling high-voltage apparatus, he always kept one hand in his pocket. He insisted that all his laboratory assistants take this precaution, and to this day it is always employed by sensible experimenters around potentially dangerous equipment.

Tesla's explorations in higher frequencies and in the field of incredibly high voltages paved the way for modern electronics, although the word had not yet even been coined. With his unique high-frequency transformers (Tesla coils) he showed that he could actually pass millions of volts harmlessly through his body to glow-tube lamps held in his bare hands. They would light up to full brilliancy from the high-frequency, high-voltage currents. In those early days he was actually demonstrating neon-tube and fluorescent tube lighting!

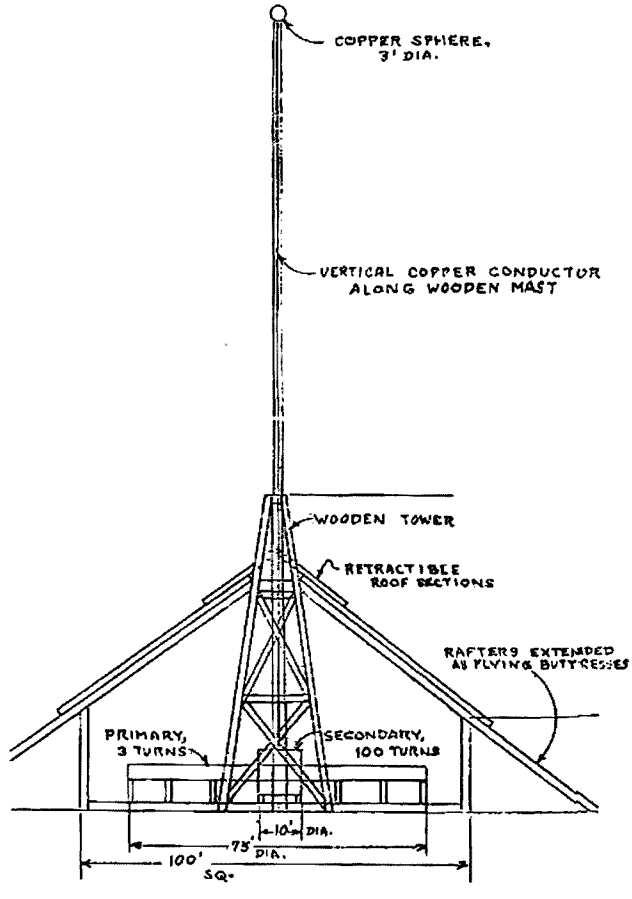
Tesla's experiments up and down the frequency scale sometimes led him into unexplored regions. Studying slow mechanical or physical vibrations, he caused a virtual earthquake in the vicinity of his new laboratory on Houston St. His mechanical oscillator, approaching the natural period of the building itself, threatened to tumble the old structure. Furnishings in the police station over a block away began to dance around mysteriously as Tesla confirmed his mathematical theories of resonance, vibration and "natural periods."

World's Most Powerful Transmitter

Investigations of high-voltage and high-frequency electrical transmission led Tesla to construct and operate the world's most powerful radio transmitter, on a mountain near Colorado Springs. Around the base of a 200-foot mast, he built a 75-foot diameter air-core transformer. The primary was only a few turns of wire. The secondary within it was 100 turns, 10 feet in diameter. Using power from a generating station several miles away, Tesla created the first man-made lightning. Deafening bolts 100 feet long leapt from the 3-foot copper ball at the top of this mast. The thunder was heard as far away as the horizon. He was using voltages of the order of 100 million – a feat not to be equalled for half-a-century.

Tesla burned out the power plant generator with his first experiment but repairing it, continued his experiments until he was able to transmit power without wires for a distance of 26 miles. At that distance he was able to light a bank of 200 incandescent lamps – a total of 10 kilowatts. Fritz Lowenstein, later to become famous for his own radio patents, witnessed this spectacular accomplishment, as Tesla's assistant on the project.

In 1899, Tesla had somehow spent the last of the money he got from Westinghouse for his ac patents. Colonel John Jacob Astor came to his financial rescue, and put up the necessary $30,000 for the Colorado Springs experiments. Now this money was also gone, and Tesla returned to New York.



The 100-million-volt transmitter, power from which lighted 200 50-watt lamps at a distance of 26 miles.

Enter J.P. Morgan

In New York, Tesla was prevailed upon by his friend Robert Underwood Johnson, editor of *Century* magazine, to write a feature story describing his accomplishments at Colorado Springs. But the story Tesla turned out proved to be an involved discourse on the subject of philosophy and 'the mechanical process of humanity." Although of the highest literary quality, the treatise said little about the powerful transmitter at Colorado Springs. Johnson had to return the manuscript three times before getting some coverage of the subject he had requested.

In the end, the article was published under the title, "The Problem of Increasing Human Energy.'' It created a sensation when it appeared in print. One of the readers who was deeply impressed was John Pierpont Morgan, who had financed the General Electric Co. in its pioneer dc days, and more recently its part of the Niagara Falls project. Morgan was fascinated by the genius of Nikola Tesla, by his spectacular accomplishments and his winning personality. Tesla soon became a regular guest at the Morgan home. Impeccably dressed, always the polished gentleman with European manners and cultured speech in several languages, Tesla became a favorite of New York and Newport society. Many prominent matrons regarded him as a "good catch" for their daughters, but Tesla insisted that there was no room in his life for women and romance -- that they would interfere with his research efforts.

Historians differ on what motivated Morgan to finance Tesla's next big project. Some believe that he was genuinely interested in the wireless transmission of power. Others argue that – in the light of subsequent developments – it seems obvious that Morgan's interest was in getting control of Tesla and his achievements to protect the Morgan investments in the electrical industry.

Finding that Tesla was broke again, Morgan agreed to underwrite Tesla's project of transmitting electric power without wires. In 1904, Tesla acknowledged in *Electrical World and Engineer*: "For a large part of the work I have done so far I am indebted to the noble generosity of Mr. J. Pierpont Morgan."

From this alliance sprouted the fantastic "world-wide-wireless" tower on Long Island.

World Wide Wireless

The strange structure that slowly rose near Wardenclyffe, in the hilly portion of Long Island, mystified all observers. Resembling nothing so much as a huge mushroom, except that it was not solid, it had a lattice-work skeleton, broad at the base and tapering toward its 200-foot top. There it was capped by a 100-foot diameter hemisphere. The structure was made of stout wooden members joined by copper gussets bolted to the wood with sturdy bronze bolts. The hemispherical top was draped over its upper surface with copper mesh. There was no ferrous metal in the entire structure.

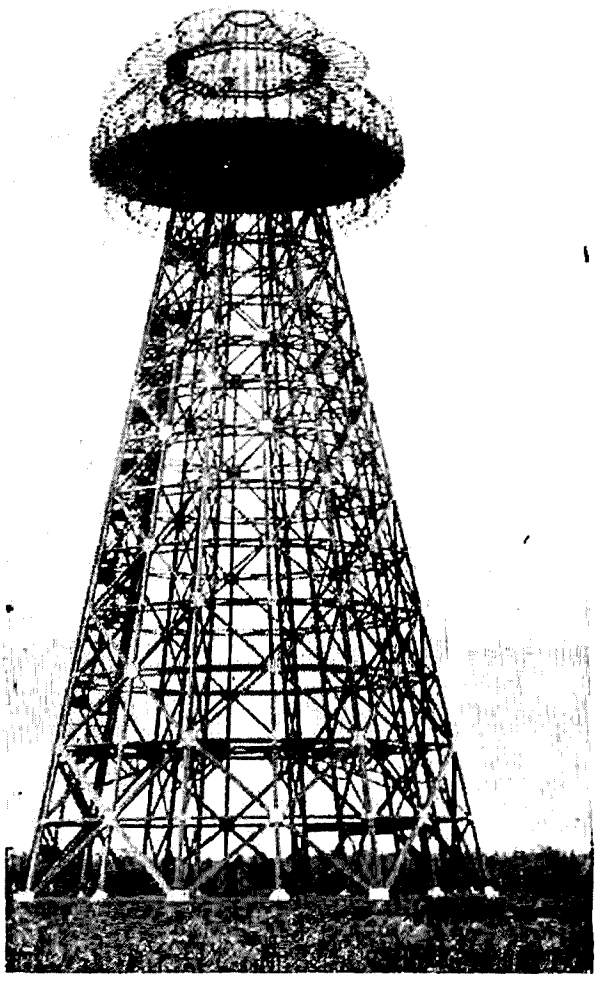
The famous architect Stanford White became so interested in the project that he did the design work without charge, assigning one of his best designers. W.D. Crow, to the task.

Tesla commuted daily to the construction from his quarters in the old Waldorf-Astoria Hotel on 34th St., riding the streetcars to the East 34th St. ferry, then the paddle-wheel steam ferry to Long Island City and the Long Island Railroad to Shoreham. The railroad's dining service prepared special meals for him so that his supervision of the project would not be interrupted.

When the 100-foot square brick power plant was completed near the base of the big tower, Tesla began moving his Houston St. laboratory into the structure. Meanwhile, annoying delays were encountered in the manufacture of the radio-frequency generators and their driving motors. Several glass-blowers were busy fashioning special tubes, the design of which still remains a mystery.

The Prophet Tells of The Future

Meanwhile, Tesla issued a descriptive brochure that revealed his far-reaching insight into the future of the great industry that at that time (1904) was limited to dot-and-dash telegraphy. That document has persuaded many that the man was actually clairvoyant. He announced that the World



Not all the facts on the mysterious Long Island tower were ever known. Some believe that it was intended to transmit at low frequencies, "shaking the earth" to send signals to distances then believed impossible. Tesla foresaw a complete modern type of service, but never stated how large an area be intended to cover. But, he called it the World Wide Wireless System!

Wide Wireless system was being prepared to provide a variety of facilities, including:

Telegraph Communication, Telephone Communication, News Broadcasting, Stock Market Quotations, Aids to Navigation, Entertainment and Music Broadcasting, Accurate Time Service, Facsimile, Telephoto and Teleprinter services.

Tesla was describing the Radio City of the future, which he actually lived to see come into existence!

Morgan's Support Ends

In *Electrical World and Engineer* of March, 1904, Tesla revealed that the Canadian Niagara Power Co. had offered him inducements to locate his wireless power transmission project at their plant, and that he proposed to employ those facilities to distribute 10,000 horsepower at a potential of 10 million volts.

The Niagara project never materialized, but may have had some influence on the fate of the spectacular Long Island project. For reasons that have never come to light, J.P. Morgan had a change of heart, and Tesla's financial fountain suddenly went dry. At first Tesla refused to believe that Morgan would not arrange for the nearly finished job's completion, but Morgan's withdrawal was abrupt and final. Historians of the industry wonder why. Did Morgan lose patience? Did engineers of high repute convince him that Tesla's visions, so openly revealed in the brochure, were nonsense, and that he was wasting his money on a hopeless dream? Did he suspect that Tesla was diverting time and money to the Niagara project? The facts will probably never be known.

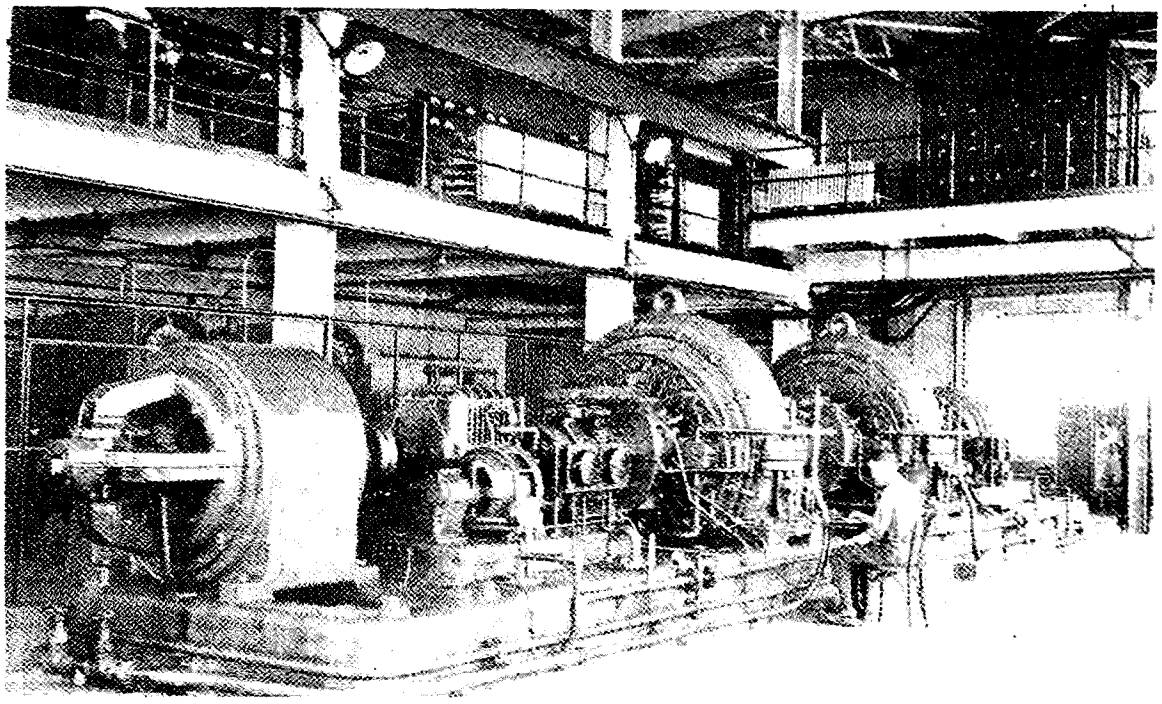
Brainless Desecration

During World War I much senseless desecration was perpetuated in the name of national defense. For some strange reason (or lack of reason) it was decided that Tesla's spectacular tower at Wardenclyffe, Long Island jeopardized the safety of the United States, and must be destroyed. After vain attempts to topple the lofty structure by attaching cable to it and trying to drag it off balance, it was finally capsized by dynamiting its foundations. Even then, the tower did not collapse nor disintegrate. It simply lay intact on its side, and was finally dismantled piece by piece.

But why did this structure have to be dispensed with? Many taller objects closer to New York City – including the Ramapo Mountains were allowed to remain intact!

The Radio-Frequency Alternator

As early as 1890 Tesla built high-frequency ac generators. One, which had 184 poles, produced a 10 kHz output. He later produced frequencies as high as 20 kHz. More than a decade was to pass before Reginald Fessenden developed his rf alternator, which had an output of 50 kW. This machine was scaled up to 200 kW by



"The Author as a Young Man," E. J. Quinby watches over the great 200 KW alternators at WII, New Brunswick, N.J.

General Electric, and put on the market as the Alexanderson alternator, named after the man who had supervised the job, and who had constructed some of Fessenden's earlier alternators.

When it appeared that British interests (already in control of most of the world's cables) were about to acquire the patents for this machine, the Radio Corporation of America was organized, at the urgent suggestion of the United States Navy. The new company was formed in 1919, around the Marconi Wireless Telegraph Co. of America, and the powerful but inefficient Marconi spark transmitters were replaced by the highly successful rf alternators. The first one was installed in New Brunswick, N.J. at station WII. It produced a 21.8 kHz signal at 200 kW, and handled commercial business previously the exclusive domain of the cables. This was the first continuously reliable trans-Atlantic radio service.*

*Dr. E. Stuart Davis, of the National Telegraph Office (Museum) in Union, N.J., happily reports that one of these giant alternators has been preserved in the Smithsonian Institute, where it stands as a monument to Tesla's pioneering. Fessenden's perservance, Alexanderson's development and Sarnoff's leadership. This one originally served at Trans-Atlantic Transmitter Station WSO at Marion, Mass.

The writer, as the most junior of the junior engineers on the project, struggled like the rest to keep the first machine running until the next was ready to provide relief. So well did these alternators perform that a whole battery of them was ordered, to be installed at Radio Central, Rocky Point, L.I., almost within the former shadow of Tesla's tower.

Thus Nikola Tesla's World Wide Wireless dream was fulfilled some three decades after he initiated the project and right where he started it, using the type of transmitter he devised.

Radar and Turbines

Tesla continued active research in many fields. In 1917 he suggested that distant objects could be detected by sending short-wave impulses to them and picking up the reflected impulses on a fluorescent screen. (If that doesn't describe radar, what does?) He described cosmic rays 20 years before other scientists discovered their existence.

At various times up to 1929, he devoted his attention to a "bucketless" high-speed turbine for steam or gas Friction between the increasingly irascible Tesla and some of the engineers and assistants cooperating with him on tests at the Edison Waterside power

plant and in the Allis-Chalmers factory did not help his cause, but many respected engineers today agree that we have not heard the last of the Tesla turbines with the smooth rotor discs.

As the years passed, less and less was heard from him. Occasionally, some reporter or feature writer would look him up and manage to get an interveiw. His prophecies became increasingly strange and involved, inclined toward the abstract and delving into the occult. He never acquired the habit of writing notes, always claiming (and proving) that he was able to retain complete detailed data on his researches and experiments in his mind. He said that he intended to live to 150, and upon reaching age 100, would write his memoirs, which would include a detailed record of all the data he had compiled during his researches and experiments. At his death – during World War II – the contents of his safe were impounded by military authorities, and nothing has been heard as to the contents of the records – if any – it might have contained.

One of the peculiar inconsistencies of Tesla's character was revealed when two high honors were offered him, and he rejected the one but accepted the other. In 1912 it was announced that Nikola Tesla and Thomas A. Edison had been chosen to share the Nobel Prize, including the $40,000 honorarium. Tesla could well have used the $20,000 at the time. Nevertheless, he flatly refused to share an honor with Edison. However, when in 1917 the AIEE's Edison Medal – founded by anonymous friends of Edison – was awarded to Tesla, he was persuaded to accept it, after first refusing.

The Esteemed Eccentric

Tesla's natural demeanor was that of the aristocrat. With the passage of time and the depletion of his resources, he sank into a condition of genteel poverty. Continuing to live in the best hotels, his credit would become exhausted and he would be forced to seek other quarters. Finally, moving into the newly opened New Yorker, he found his problems solved. Some of the organizations for which he had made millions arranged with the hotel management to take care of the aging genius.

Having once met Tesla through the mutual friendship of the intrepid Hugo Gernsback (possibly Tesla's last friend) this writer later recognized the distinguished pioneer strolling in the grand concourse of the Pennsylvania Terminal. Impeccably dressed, his head bowed low over his pristine collar and red-and-black silk necktie, his whole bearing was that of a high-born nobleman from the past.

"Good evening, Dr. Tesla," I ventured, disturbing his solitude in the midst of the turmoil. "Are you catching a train for somewhere?' His soft-spoken reply was memorable. "No,' he explained, "I often come here to think."

Tesla insisted on carefully wiping each item of silverware, china and glass before starting a meal, using a fresh napkin for each. In view of this effort to achieve perfect sanitation, it seems inconsistent that the maids reported Tesla's room to be an "unholy mess." It wasn't Tesla's untidiness they complained about – it was the pigeons! When he was not feeding them out in the park, he fed them in his room, where he left the window open so they could come and go.

The gold-plated telephone beside his bed, over which he enjoyed a universal frank to talk to anyone anywhere in the world without charge, was the roost of his favorite pigeon, a white one with grey-tipped wings. "When she dies, I will die," predicted Tesla.

And so it was that one day in January 1943, his favorite dove paid him her last visit. "She was dying," lamented the lonely, unhappy Tesla. "I got her message, through the brilliant beam of light from her eyes."

One of the maids, observing that the "Don't Disturb" sign had been hanging on Tesla's doorknob for an unusually long time, used her pass key to investigate. Tesla had passed to his reward, leaving his gaunt 87-year-old frame peacefully in bed. She fed the mourning pigeons, gently ushered them out, and closed the window.

. . .Quinby

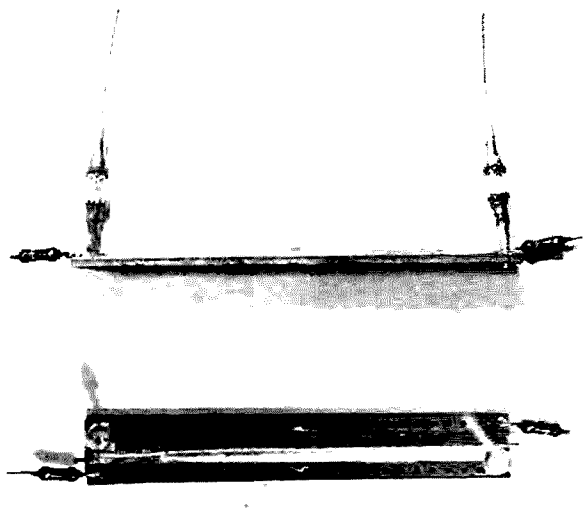
Author's Note: I am indebted to the late Hugo Gernsback, friend and confidant of Nikola Tesla; to *Prodigal Genius*, the biography of Tesla by John J. O'Neill; to the *Proceedings of the AIEE*, and various publications for help and information.

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A SIMPLE VHF SWR METER

I recently wanted to do some work on a 2 meter antenna and since no other instrument was handy, started to use an SWR meter manufactured for use on the high frequency bands. After some erratic results, it was decided to check the SWR meter accuracy on 2 meters with some carbon resistors to simulate different SWR's. The results readily confirmed that the SWR meter was useless at VHF unless one didn't care whether a SWR was really 1:2 or 1:5. Rather than purchase another SWR meter, it was decided to construct one that would render reasonable results, within 10% accuracy or so, on the VHF bands, particularly 144 and 220 MHz.

There is nothing basically new in the circuitry of the SWR meter to be described. What is different about it is that it utilizes a particularly simple and inexpensive method of construction that yields reasonable results. It can be constructed as a completely self-contained SWR meter or only the pickup element can be constructed and used with an external meter. The circuitry as shown here for the meter utilizes two meter



The heart of the SWR meter is a carefully constructed pickup element. Details of construction are discussed in the text but the photo shows how closely the diodes and terminating resistors must be soldered to the pickup element.

movements so one can read forward and reflected power simultaneously and avoid the annoyance of having a forward-reflected switch arrangement for a single meter.

Pickup Element

The "heart" of any SWR meter of the reflectometer type is the pickup element. Many elaborate forms for such elements have been devised which involve complicated mechanical construction. Such complicated construction does become necessary if very accurate results are desired and if the meter is to maintain linearity over a very wide frequency range. However, over a smaller frequency range and with some minor sacrifice in accuracy, the construction of a pickup element can be greatly simplified. Basically, the pickup element should not cause any discontinuity in the transmission line section in which it is inserted but yet be long enough so enough voltage can be picked up in both the forward and reflected directions to make the meter usable with even low power transmitters.

The pickup element I devised is shown in the photo. It is a 2-7/8" long piece of alternate grid pre-punched perf-board stock. The board is about 7/16" wide and within this width contained 4 separate copper strips spaced about 1/16" or less apart. The center two strips are soldered together to act as the inner conductor continuation of a coaxial line section. To solder the two inner strips together tack solder a bare piece of hookup wire between the two strips and then cover the entire two strips with solder.

Without the use of pickup wire, it will be nearly impossible to develop a smooth solder

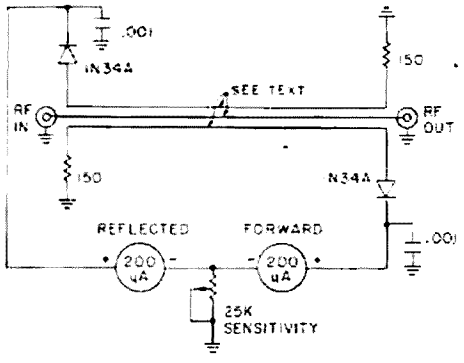


Fig. 1. SWR meter circuit. Two identical meters should be used (current range and internal resistance).

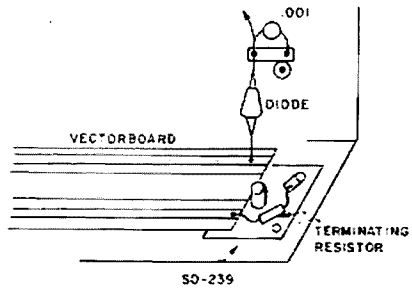
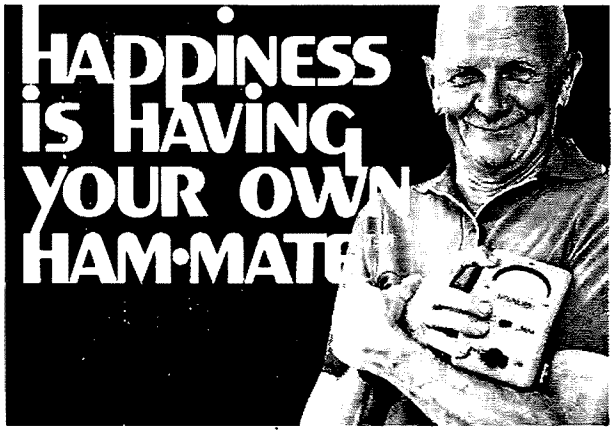


Fig. 2. Center strip of vector board is soldered to center post of SO-239. Other components are mounted at each end of board as shown (only one end shown here).

flow between the strip. Each outer strip acts as a pickup element for the SWR meter circuit shown in Fig. 1. The terminating resistor and diode are soldered to each end of the outer strip as shown in the photo and with minimum excess lead length to the strip. The use of a heat sink on the diode is necessary to prevent damage during soldering.

Mounting The Pickup Element

The pickup element made from the board stock is mounted between two approximately spaced SO-239 chassis connectors. The center strip of the board is soldered at each end to the center post of the SO-239 connector. The terminating resistor at each end is grounded as directly as possible to a ground lug held in place by one screw of the SO-239 mounting hardware. These details are shown in Fig. 2. It is important that the terminating resistor be grounded in this manner with minimum lead length. The enclosure in which the pickup element is contained should just be wide enough to accommodate the SO 239 connectors so that when the enclosure is secured together, the pickup element is boxed in by a metal surface on each side except directly above it. Many chassis or enclosure types are suitable for this purpose and the overall size of the enclosure will depend, of course, on the meter used and sensitivity control placement. These details are not covered here because they can be made as desired. They will not affect the basic accuracy of the meter as long as the pickup element is properly mounted and enclosed. The bypassing of the pickup rectifier diodes must also be done with as short leads as possible on



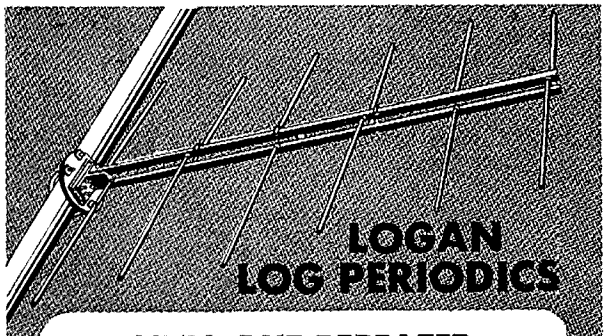
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the bypass capacitor. As shown in Fig. 2, a two lug terminal strip (one lug grounded), mounted on the side wall of the enclosure immediately at the cathode end of the diode will perform this task very well. The length of the IN34A diodes is such that the bypass capacitor cannot be connected to the same ground lug used for the terminating resistor. The leads on the capacitor would be too long and it will be ineffective.

Operation and Results

The dual meter circuit of Fig. 1 reads forward and reflected power simultaneously. The sensitivity potentiometer is set to read full scale on the forward meter and the SWR read directly from the reflected meter. The latter meter can be calibrated for various SWR's by the use of small carbon resistors (100Ω to simulate a 1:2 SWR in a 50Ω line, etc.). Usually, it is only necessary to calibrate the reflected meter for SWR's of 1.5, 2 and 3 at the frequency of interest. Calibrated in this manner, the accuracy of measurement will be roughly 10% and is certainly good enough for most general antenna work. A particularly nice meter display can be made if one can find a two meter movement in one enclosure. I purchased a surplus stereo VU meter which had dual 200 μA movements and used it in the SWR meter.

The sensitivity of the SWR meter is such that transceivers of the 1-2 watt output class can easily be used with it on the VHF bands. The basic meter, of course, can also be used on the lower frequency bands as well and it will retain good accuracy. The only problem on the lower frequency bands is that the pickup strips are so short that more transmitter power has to be used to activate the meter than is usually convenient to use during antenna experiments. No exact tests were made but probably 70-100 watts would be needed to use the meter on as low a band as 80 meters. The meter was used and checked, however, on 40 meters. The accuracy of the meter remained very good and full scale deflection of the forward level meter required a power level of 60 watts. Being an in-line type meter, it can be left permanently in line when used on any band with a minimum of loss.

. . .W2EEY

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BETTER CONTROL FOR TRANSISTOR REGENERATIVE RECEIVERS

From time to time, various amateur magazines have had notes on using transistors in regenerative detector circuits. Some time ago, I made a two-transistor receiver, and immediately ran into trouble with the regeneration. The problem was that as the regeneration control was advanced to the point of oscillation, the received frequency was "pulled," and stations disappeared as I tried to tune them in. Also, the start of oscillation was very violent, and when the control was backed off, the dropout was equally sudden and uncontrollable. Some couple of years ago, in 73*, there were a few brief notes on using transistors in regenerative circuits. It was suggested that large values of tuning capacitance and small coils would tame the regeneration, and when this was tried, a big improvement was noticed. The result was that a quite usable unit was made for 3.5 MHz, to operate as a companion to a 1W portable transmitter.

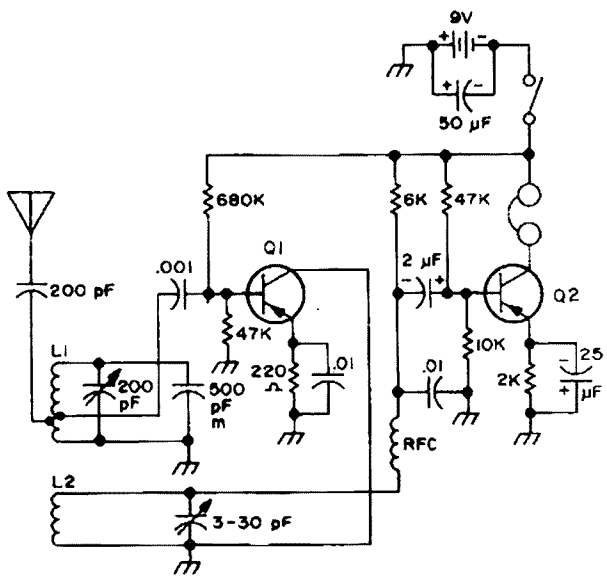


Fig. 1. Revised circuit. Q1 = 2N370, 2N371, 2N372 or 3N2083. Q2 = OC70 or OC71.

Recently, it was decided that the portable rig would be more useful on 7 MHz. The transmitter, (dreadfully old fashioned as it uses a 1T4 and a 3A4) was easily modified, but all attempts to make the two-transistor receiver operate effectively on 7 MHz proved futile. The regeneration just wasn't controllable. The regeneration control was a variable resistor, which not only controlled feedback, but varied the collector voltage. It was reasoned that the frequency shift was due to junction capacitance changes with varying voltage, and this effect would naturally be worse at the higher frequencies.

I then remembered that when I made my first one-tube receiver, in 1946, the regeneration control was not a potentiometer, but a variable capacitor, and the tube's plate voltage was fixed. Maybe the old ways are best; maybe not – but I thought it was worth a try. A simple change in the circuit to that shown in Fig. 1 brought instant improvement. The transistor can now be slid gently in and out of regeneration, and there is only a few hertz shift in the received frequency when this occurs. The receiver is now quite usable on 7 MHz, and I am looking forward to regular QRP contacts during afternoon outings. I throw my antenna wire into a tree, ground the rig to a 40 ft wire, and let it go – all 1.3W of it. The two-transistor regenerative receiver is giving a good account of itself on CW and would make an ideal "last resort" receiver, or as in my case, a real QRP portable unit.

. . .VK3IQ■

**Reference: "Superhet or Regen," K6BIJ, March 1964 "73" Page 58.*

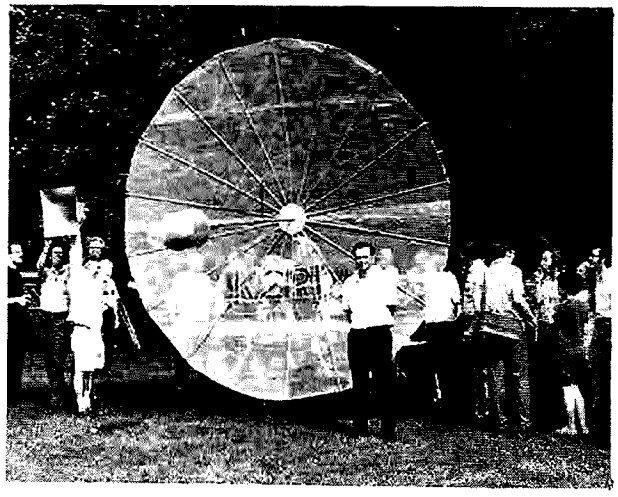
Charlene Knadle WB2HJD
316 Vanderbilt Parkway
Dix Hills NY 11746

"WHAT'S AN ANTENNA MEASURING CONTEST?"

You'll see," my husband of one year directed. His answers to my further inquiries had me envisioning a large crowd similar to that at a Fourth-of-July fireworks display, with picnickers gathered around plentiful tables and short-order food easily available. On some sprawling platform would be an impressive array of electronic hardware, with a master of ceremonies comparing antennas and from behind a microphone announcing auctioneer style the relative merits of each.

Disillusionment was inevitable when the apparently deserted park finally revealed a small group of people huddled around a few wires. One portable shanty sold candy bars and potato chips. Club funds had been used to supply a tub of ice filled with cans of soda. No other food was available. Gradually some thirty people filtered in, about half of whom brought strange-looking contraptions made of wire, screen, wood and sheet metal, almost none of which I had been used to seeing as antennas.

We walked around looking in on people here and there, and having brief conversations with passing strangers wearing call-letter badges. Everybody seemed to be busy doing nothing, but for some reason my husband radiated excitement and anticipation. I decided there must be something more to come. "They're starting!" Dick said, and abandoned me to rush, camera in hand, to the original group with the wires. I hurried to the spot, fearful of losing a good position for observation. But no one gathered around. There were no official announcements. I asked Dick if anything had gone wrong. Someone was holding up a square megaphone with a wire attached to it, but saying nothing. "No," Dick answered, "It s okay." I stepped in closer to get a better look. "You're in the way," Dick said. I stepped back and almost slammed into a mass of uniformly-spaced spikes being held waist-high.



Dick K2RIW stands in front of his 12-ft. dish which won in both categories, as Dick W2IMU makes a reference measurement with a standard gain horn.

"When will they start?" I asked ingenuously.

"They already have. That's the third antenna."

When it dawned on me that what I was seeing was all there was, I resolved to discover the point of interest by attempting to understand what was happening. I in-

quired about the measuring process, reprocessing the answers to conform to my limited understanding.

Several years and a legitimately-earned license later, I have come to better understand the enjoyment of an antenna measuring contest. But the East Coast VHF Society has grown in those years, too, and the August 1971 annual ECVHFS Antenna Measuring Contest was vastly different from that first one I attended. Picnickers were already hovering comfortably around tables when we arrived at Saddle Brook Park, New Jersey, and quite a crowd was wandering in the pavilion, where a noise-figure measuring contest, a tube guessing contest, and a QSL card competition would soon be getting underway. A tightly-massed gathering identified the registration table where tickets could be obtained for the drawing to be held later. A picnic table with a receiver and calibration equipment had already been set in the field, and 125 ft further out the signal generator waited.

Friendly waves greeted us as we pulled into the main area, and almost before the car came to a stop we were surrounded by inquisitive amateurs eager to watch us assemble Dick's portable 12 ft-parabolic dish and to examine the "goodies" Dick habitually brings along. I set up the baby's playpen and turned away from him and the friendly XYLs to lend my husband the usually much-needed hand, but discovered he already had all the help he needed. I got out



Paul, president of the ECVHFS, holds up the 1296 MHz standard gain horn, as a former president, Al K2UYH, looks on benignly.



QMs with quads collinears, dishes and yagis wait patiently as calibrations are made before their antennas are measured.

the camera and began snapping familiar faces, interesting-looking antennas, and contest activities. When the dish was fully assembled and the competition was about to begin, I interrupted Dick in his technical discussion with several other amateurs to force him to eat a sandwich. A respected amateur requested a picture. Then came the rain, a circumstance luckily avoided at all earlier ECVHFS contests in my experience. Everyone gathered in cars and in the pavilion. Our baby napped in his car bed. As the skies gradually cleared, a young couple accidentally wandering into our area approached the amateurs in the truck near our car, and pointing to a large parabola asked what it was. The straightforward answers were so badly misconstrued and the simple functions of the antennas held in such naively exaggerated awe that I, overhearing, couldn't help but chuckle, remembering my first exposure.

The measuring resumed and the crowd, fortified by amateurs returning from the nearby ECVHFS ham radio auction and flea market, filtered back into the field, some 130 strong. Somebody tapped me on the shoulder. "Do you believe in God?" It was a two-man team taking a religious "survey." I gave them answers to their brief oral questionnaire, dismissing them courteously. Somebody was cooking hamburgers on an hibachi. Two amateurs worked together to repair an antenna with a Bernz-O-Matic torch. Amateurs inquired about the gains of each other's antennas and generally gos-

sipped. DB's written on contest forms were compared for the 26 antennas entered in two categories. A ham received congratulations for having won the noise figure measuring contest. A child played with a stuffed animal won by a parent in the drawing. Someone handed out cucumbers from his Pennsylvania garden. Certificates were issued and plaques given to the 432 and 1296 MHz antenna measurement winners. An ARRL official capitalized on the occasion to present an award of achievement to an amateur. Just as the crescendo of activity began the descent, it began to rain again. Amateurs, YL's, XYL's, supplies, antennas and children were packed into cars and the homeward treck was begun.



These technical diehards won't let a little rain ruin their chance for an eyeball QSO. Left to right are Bill W2DWJ, Dick K2RIW, Reed W2CQH and Al K2UYH.

We began dismantling the dish in the downpour. "What about lightning?" I insisted.

"Don't worry about it."

What's an antenna measuring contest? It's a serious electronic effort: a place to announce an antenna of your own design or to measure the gain of a favorite commercial one. It's a chance to exchange ideas or equipment; it's a family picnic, a brag-and-gossip session, a place to display your specialized electronic acumen, an opportunity to meet friends as well as the serious VHF amateurs; it's an experience. But you've got to see one for yourself.

. . .WB2HJD

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Brian D. Ripley WA8VHG
919 E. McDevitt
Jackson MI 49203

SSB ON 432 MHZ

Recently, after a fruitless evening of calling CQ on 432, I decided it was time more hams were encouraged to use this interesting band. Most people think that 50 miles on 432 is real DX. That's just not true. Although my best DX this past year was only 415 miles, many hams cover distances as great as 700 miles: some claim more. SSB is now starting to come into greater use, and does show its worth on 432, so I decided to put together a complete working unit. This unit is a modified version of a design by K7RKH that originally appeared, in part, in the old VHF'er magazine.

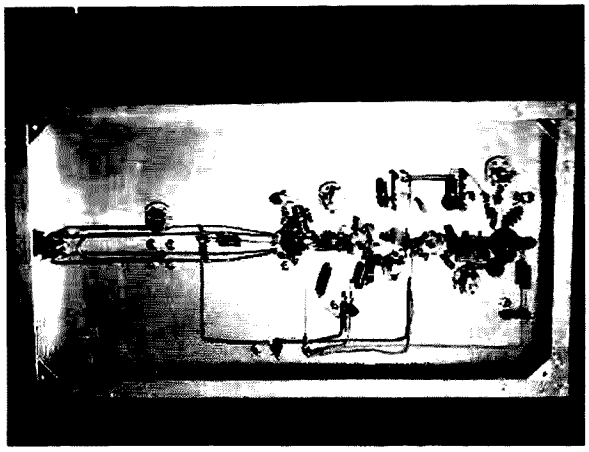
When building this mixer I decided that, while the General Class operators would probably be more inclined toward construction, there are also many Technicians with 50 MHz SSB who would like to get on 432. With this idea in the back of my head, I chose 50 MHz as the mixer input frequency.

While some 432 MHz mixer designs have appeared in print, it appears that few hams have completed rigs that work with much success. One reason for this may be they have not been able to obtain the degree of oscillator stability required. Some have gone to the extreme of building a transistorized oscillator inside a thermos bottle, burying it in the ground and letting it run 24 hours per day. This of course results in excellent stability. With a little care my oscillator chain will equal or surpass the current 432 rigs. Keep in mind that only one hertz change in the oscillator will give you a change of 54 hertz in the output.

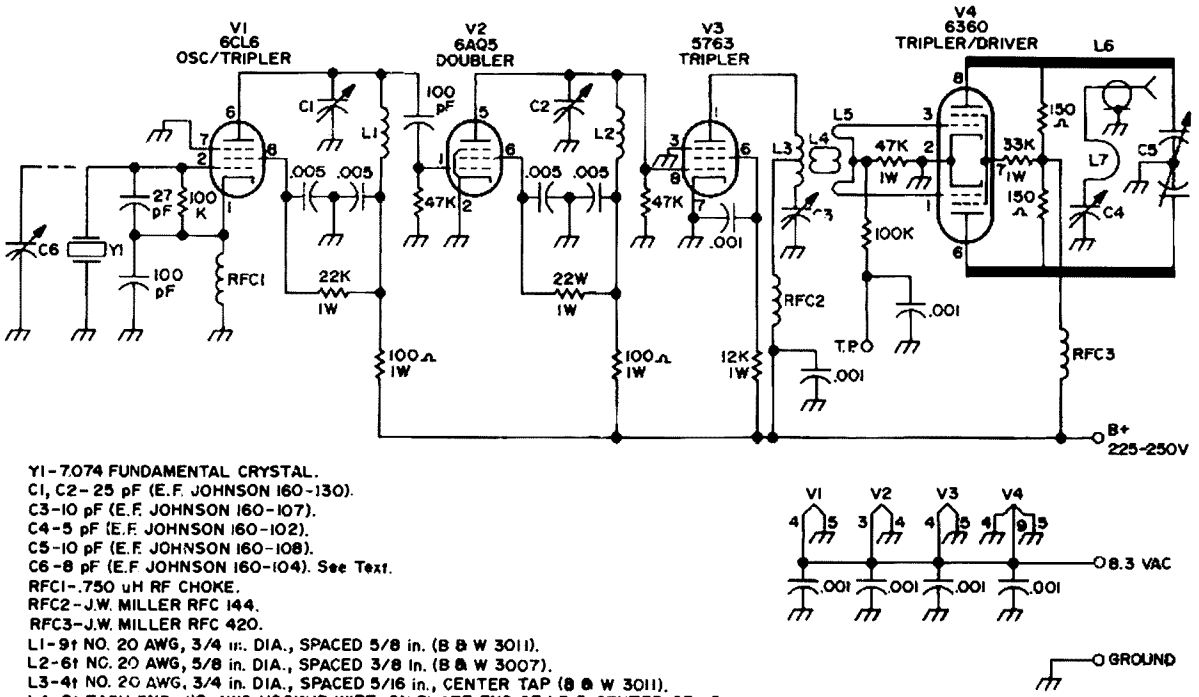
At VHF/UHF the use of choice selected hardware such as ceramic tube sockets, good quality resistors and capacitors and constant-impedance connectors is a must. Those inexperienced in working with 432 circuits should use a copper chassis, but advanced experimenters can construct this oscillator/mixer on other materials such as aluminum, using the necessary precautions such as short leads, direct ground paths, and



The 382 Mc oscillator chain is on the left, the 432 Mc mixer with an added buffer amplifier in the center. and a 500 watt cavity on the right.



Bottom view of the oscillator chain, with C6 at the lower left and L6-L7-C5 at the right.



Y1-7.074 FUNDAMENTAL CRYSTAL.
C1, C2-25 pF (E.F. JOHNSON 160-130).
C3-10 pF (E.F. JOHNSON 160-107).
C4-5 pF (E.F. JOHNSON 160-102).
C5-10 pF (E.F. JOHNSON 160-108).
C6-8 pF (E.F. JOHNSON 160-104). See Text.
RFC1-.750 uH RF CHOKE.
RFC2-J.W. MILLER RFC 144.
RFC3-J.W. MILLER RFC 420.
L1-9t NO. 20 AWG, 3/4 in. DIA., SPACED 5/8 in. (B & W 3011).
L2-6t NO. 20 AWG, 5/8 in. DIA., SPACED 3/8 in. (B & W 3007).
L3-4t NO. 20 AWG, 3/4 in. DIA., SPACED 5/16 in., CENTER TAP (B & W 3011).
L4-2t EACH END, NO. AWG HOOKUP WIRE, ON PLATE END OF L3 & CENTER OF L5.
L5-8t NO. 16 AWG, 5/16 in. DIA., CENTER TAP, SEPARATE INTO 4 TURNS EACH, 1/8 in. APART.
L6-5-1/2t NO. 12 AWG SOLID, SEPARATE 3/4 in.
L7-4-1/2t NO 12 AWG SOLID, BEND INTO U SHAPE, 3/4 in. WIDE, PLACE 1/8 in. ABOVE L6 (PICTORIAL)

Fig. 1. Circuit diagram of the 382 MHz oscillator chain.

proper bypassing/decoupling. Shielding per se is not a critical factor here as power generation itself was not the desired end product.

Construction

The oscillator chain is constructed on an aluminum chassis 2x7x13 in. Be sure to make preliminary parts layout, as the full length of the chassis will be used. If you are not experienced at building VHF circuits it is recommended that you build only one stage at a time and get it working before proceeding to the next. The mixer was built on a separate 2x5x7 in. chassis for experimental purposes, but you may want to build both on a larger common chassis.

You need not include frequency adjust/variable capacitor C6, but if you do it will give you about 100 kHz change at the output frequency, more than enough to correct for crystal error, or to enable you to move to a predetermined frequency. With proper adjustment of C6, you could actually go to full transceive, but in actual practice a fixed crystal frequency would be better in case you are running skeds.

Tuneup

A grid tip meter is an absolute must. Without one you will not have much success in tuning up because the tuned circuits will actually pick either the second or third harmonic of the previous stage. Dip each stage as follows: C1/L1 dip to 21.222 MHz, C2/L2 dip to 42.444 MHz, C3/L3 dip to 127.333 MHz. There is only one dip in C5/L6, so it is a simple matter to peak for maximum rf output. To assist in tuneup, construct an rf indicator from a GE49 pilot bulb and a 1 in. loop of hookup wire. After each L/C circuit is dipped, apply filament and B+ voltage. Starting with the oscillator, hold the indicator near the plate end of each coil and peak for maximum output. Now go

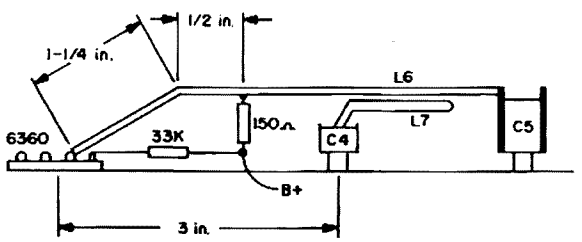


Fig. 2. Side view of 6360 tank circuit showing parts placement.

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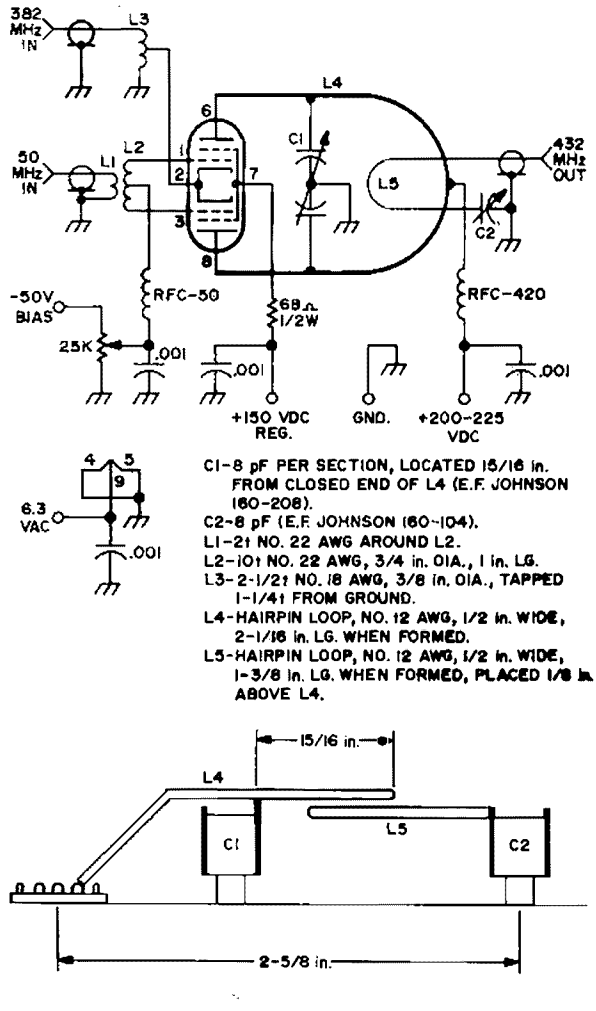


Fig. 3. Circuit diagram of the 432 MHz mixer, and the pictorial of the tank circuit.

back and redip each coil to make sure you are still on the proper frequency. When each stage is in tune there will be enough output to brightly light your indicator. While tuning C3/L3 for maximum output, couple your indicator to coil L5 and peak C3. Now connect a vom or vtvm to point "TP" and set your meter to read 100V dc. Again apply power and tune each capacitor for a peak reading on your meter. The final reading should be 50–85V dc. When tuneup is completed you should have 3–4W of 382 MHz rf, much more than will be needed, but the excess will help to overcome circuit losses.

Mixer

A 6360 works as a mixer with suitable modifications, but it requires more drive and injection. A 6939 costs more, but has more output with less drive and injection, less than half that of the 6360. The 382 MHz

injection is fed into the cathode through a tapped rf choke resonant between 382 and 432 MHz. Care must be exercised not to resonate this coil at 432 MHz, for if you do, output instability will result. The tap, placement of which is critical, provides an impedance match and expends the rf driving power efficiently for proper loading of the cathode. The vr tube for the 6939 screens is an OA2. The bias is set for 35 mA standing plate current with no drive.

The simplest method of obtaining the 1W of 50 MHz SSB, without making modifications to the rig, is to feed the full output of the driver into a dummy load with a tee connector and pull off only the amount of rf needed (Fig. 4).

Final Tuneup

Connect the 382 MHz oscillator chain to the mixer with a piece of RG-58/U coax about 14 in. long. This length can be critical, so if any problems are found, vary this length a bit. Connect the output of the mixer to a proper dummy load or wattmeter. Apply the appropriate voltages to the oscillator/mixer and adjust the 6939 static plate current to 35 mA. Now repeak the oscillator stages for the maximum voltage at "TP." Apply a small amount of 50 MHz drive and dip the mixer capacitors C1 and C2 for maximum output. Again repeak all capacitors and adjust the 50 MHz drive to the 6939 for about 50 mA plate current. With 225V on the oscillator plates, total current should be about 165 mA. Do not try to run the oscillator chain at its maximum input as the increased output if not needed and a lower input level will give you a much more stable unit. Allow at least 15 minutes warm-up before making the final frequency adjustments.

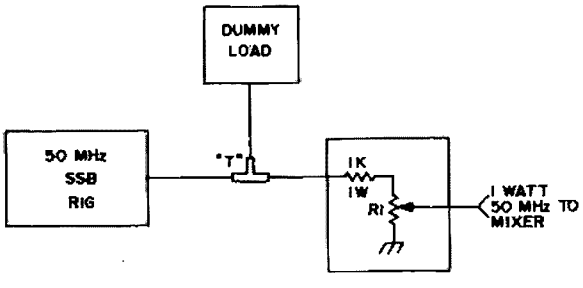
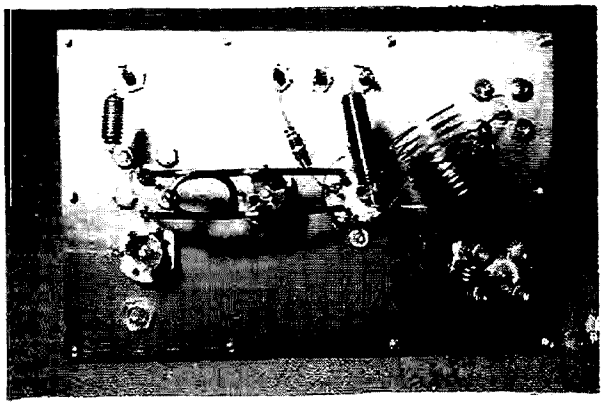


Fig. 4. Method of obtaining low level drive to the mixer. R1 is a 1K A.B. composition pot. This may be built in a small minibox using rf connectors.



Bottom view of the 6939 mixer, with L5-C2 at the left and L3 at the lower right.

Summation

If problems such as FM'ing should be encountered, decrease the 50 MHz drive, since we're more interested in quality than in power. You should now have enough output to drive such tubes as the 6939, 5894, 2C39, and, amazingly enough, should be able to drive a 4X250 to as much as 135W input, class AB1.

It is always recommended that a filter be used on the output of any mixer worked directly on the air. When driving low Q buffer or amplifier stages, some of the spurious energy such as 382 MHz will get through to the output. Some odd loading effects will occur in broad frequency amplifier stages because the 382 and 432 MHz energies are relatively close together for a UHF circuit. A strip line filter between the mixer and the final amplifier stage is highly recommended. Refer to the ARRL VHF Handbook. Even an output filter is desirable. Although I have only used CW and SSB the 50 MHz drive may be almost any mode – CW, A3, SSB, FM, FSK, PM, or what have you – but the modulation/purity index must be clean or it will show up in the output.

If this mixer is used as a source signal directly for tuning up 432 antennas, the swr bridge will go crazy and will not give readings truly indicative of tuning or antenna performance.

I am using a Heath SB–110 as the 50 MHz driver, using the auxiliary transmit with a 5.031 crystal (about 432.030) in the auxiliary oscillator and have had good on-the-air comments. See you soon on 432 SSB.

. . .WA8VHG

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North Wales, PA 19454

A 185 AMPERE AC ARC WELDER

The welder, although not an essential item in the hamshack, is a welcome addition to the experimenter's supply of tools. It serves such areas as tower construction and general repair. The high cost of an adequate commercial welder and my native curiosity started me on this project which has seen a year and several different transformer designs pass. The present unit is the culmination of my experimentation. It is a continuously variable unit that will weld to 185 ac amperes maximum. The duty cycle for this unit at maximum current is about 15%, which would not satisfy the industrial user, but for the average shop is quite adequate. A simple duct and fan cooling arrangement could raise this value.

The type of transformer I have designed allows one to control the leakage of the unit, which in turn controls the maximum amount of current that can be drawn. By varying the amount of leakage, one can control the current available at the welding electrodes. Most transformers are designed to minimize leakage. This application is an exception. The formula used to calculate the number of turns for the primary and secondary windings is:

$$V/N = 4.44\ B\ F\ S\ A \times 10^{-8}$$

B = flux density in gauss (flux is the number of lines of magnetic force and is dictated to a certain degree by the metal used in the core).

F = frequency of operation of the transformer (in this case 60 cycles).

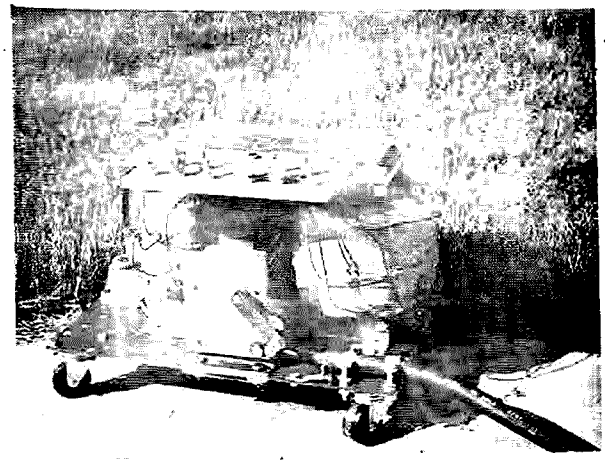
S = stacking factor (this allows for varnish between the laminations of the iron core).

A = cross-sectional area of a core leg in square centimeters.

V = volts applied or desired.

N = number of turns required.

After choosing the flux density at which to operate the transformer, considering the iron used (I chose 15,000 gauss), the other terms are fixed by external conditions, except for the number of turns and the cross-sectional area. I picked a cross-sectional area that would be large enough to



The completed welder. Note the on-off switch, fuses and shunt mechanism in place.

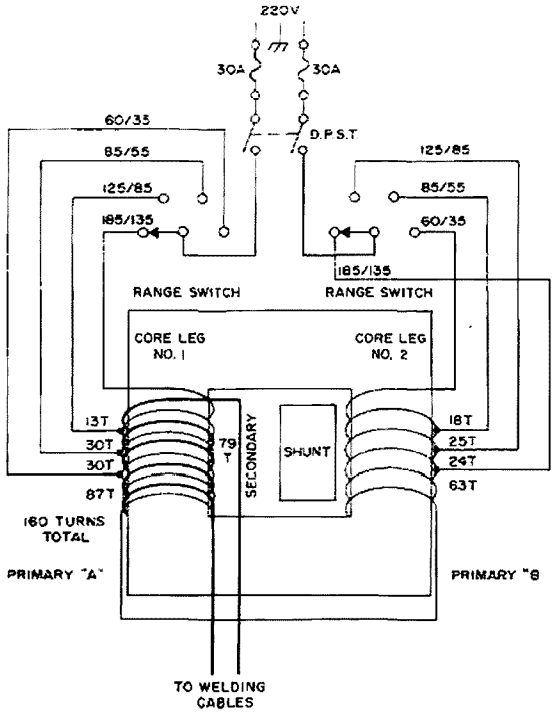
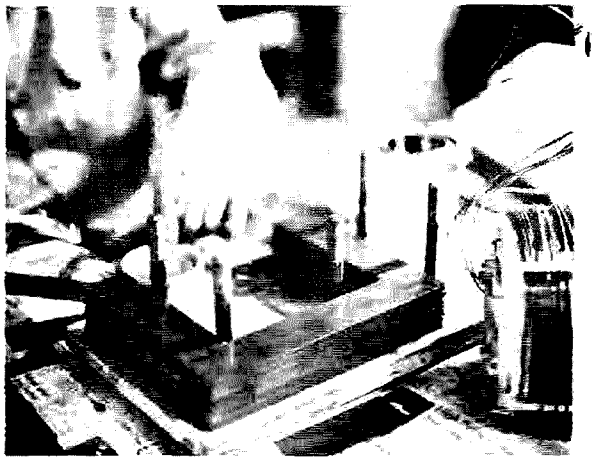


Fig. 1. Welder schematic.

give a reasonable value for the number of turns required. The cross-sectional area that was chosen required approximately 235 turns on the primary (the winding connected to the 220V main line) and 79 turns on the secondary (the winding the welding cables are connected to).

To vary the leakage of welding current, there are two controls. The range switch, which is the coarse current control, actually varies the proximity of the primary winding to the secondary winding by a series of taps which puts a greater or lesser part of the primary directly over the secondary and the rest around the other leg of the core. The farther apart the primary and secondary, the greater the leakage and the lower the welding current. Vernier current control is accomplished by sliding a laminated iron bar between the two coils and thus shunting flux away from the coil on the other leg of the transformer (leg 2), see Fig. 1. Flux is the term used to describe the magnetic field which couples the primary to the secondary and thus allows the transformer to function. The less flux, the less coupling and the lower the welding current.



Here, the U-shaped part of the core is being assembled. The large bolts and plywood base are part of the temporary clamping device for the core.

Construction

The core itself is a laminated structure made of .025 in. thick .25% silicon steel sheet. Plain cold rolled steel will serve if the silicon steel cannot be located. The steel is cut into strips as per Fig. 2. The laminations are then assembled with varnish in alternating layers 1 and 2 (Fig. 2). A metal shear is necessary to cut the laminations. Make sure that the shear is in good condition or you may have to file burrs off each and every lamination since it is necessary to avoid metal-to-metal contact between the laminations. If liberal amounts of varnish are used and the laminations are reasonably free of

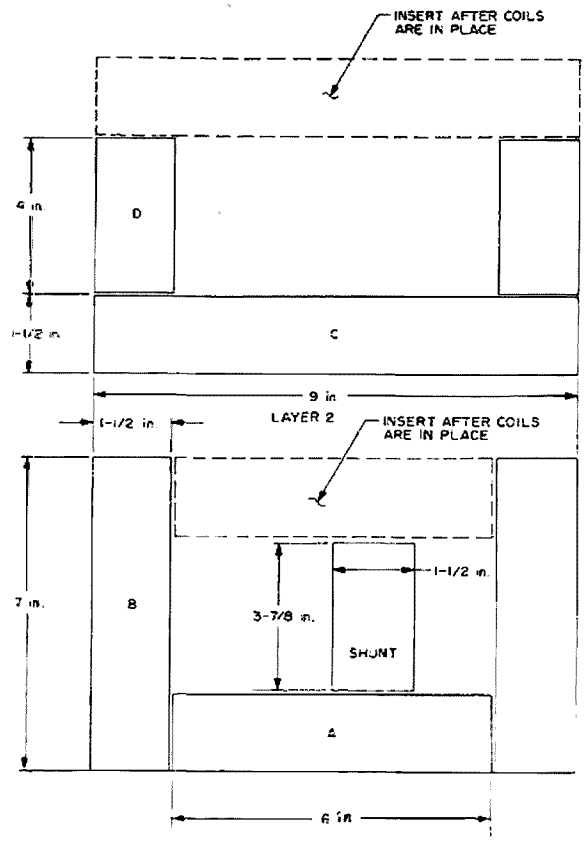


Fig. 2.

burrs, no problems should be encountered.

After the U-shaped part of the core is completed, it should be placed between two ¾ in. plywood boards and clamped tight to remove excess varnish. After clamping, the core should be approximately 2¾ in. high. This will require approximately 109 layers of iron. The core laminations may need to be aligned after clamping the first time. Although the varnish will not completely dry for over 9 months, it is very difficult to realign the core after only a few hours, so make sure that it is square. The shunt can also be assembled at this time. The partially finished core and remaining lamination can now be put aside to cure and the coils can be wound. After a week, the clamps can be removed if the core is handled with a little care.

The first job is to build the bobbins that the coils will be wound on. They are constructed out of 3/32 in. plywood, which can be purchased at any hobby shop dealing in radio controlled airplanes. I have left out the exact dimensions for the bobbins because they should be custom fitted to your core legs. The bobbins were assembled with gauze and glue (Fig. 3).

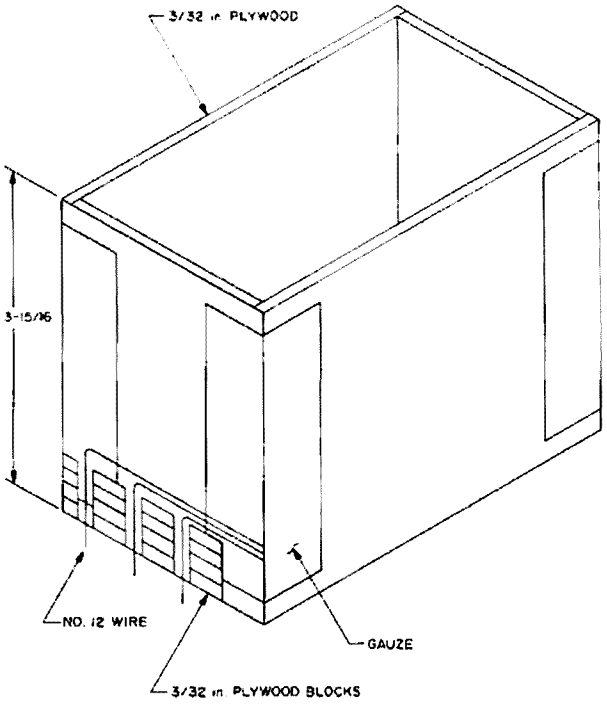


Fig. 3. Bobbin. Note: *Adjust the inside dimensions of the bobbins to fit the core that you have constructed. The bobbin shown is the one for the secondary in which three 12-gage wires are wound together. For the primary, only one wire slot is required.*

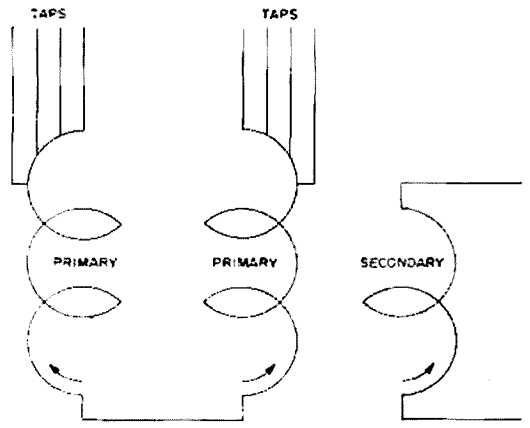
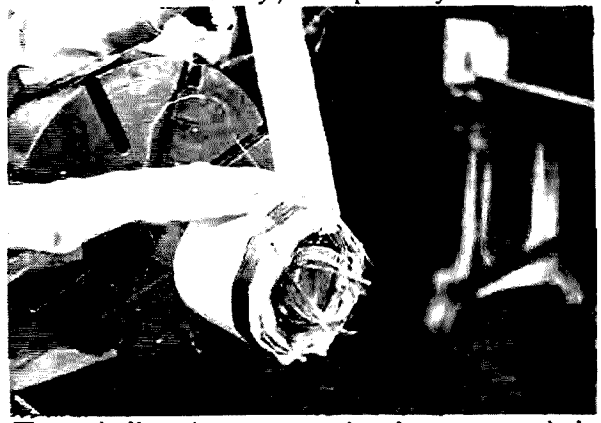


Fig. 4. Coil orientation pictorial. Note the direction of the windings of the various coils and follow it exactly!

About 700 ft of 12-gage copper magnet wire is required to make the coils. It was obtained through a local wire distributor. The secondary was wound first. It is a trifilar winding consisting of three strands of 12-gage wire side by side and wound together.

Cut a piece of wood that will just fit inside the bobbin and clamp it in a vise; then get a friend to help and start winding. Seventy-nine turns are required on the secondary (Fig. 4). This will be approximately 6 layers of wire. Between each layer place a couple of layers of paper insulation (wrapping paper is fine) and four ¼ x 4 x 3/32 in. plywood spacers on each of the four sides. Varnish the paper after it is wrapped around the coil. The air spaces provided by the plywood spacers allow for air cooling of the coils during operation. The primary coils are wound similarly, except they are mono-

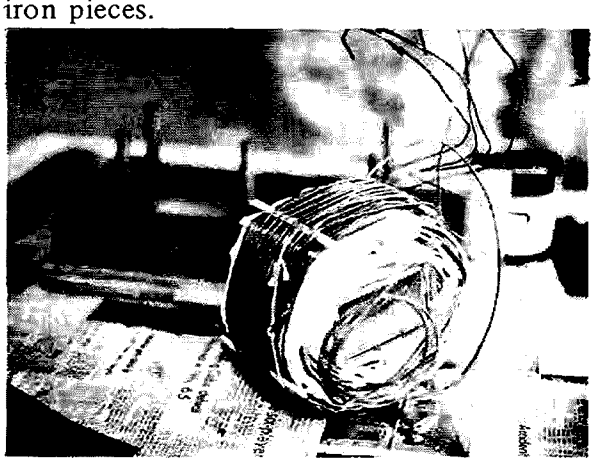


The winding is most easily done on a lathe although it can be done by hand. Note the tap wire protruding from the coil. Here, paper insulation is being placed between two layers of wire.

filar windings consisting of one strand of wire. One hundred and sixty turns are wound directly over the secondary. One hundred and thirty turns of primary are wound on the second bobbin. A layer of gauze is placed over the last layer on each bobbin and varnished.

In wiring the two primaries together, the relationship of the two coils in respect to the direction they are wound and the way they are connected together is critical, so follow the diagram to the letter. If by chance a mistake is made, the welder will hum loudly and heat up excessively when turned on. When winding the primaries, observe the positions of the taps and place them as you wind, using a 100W soldering iron and rosin-core solder. The ends of the coils, both primary and secondary, can be held securely by fastening the ends of the wire with string. Tie the string onto the end of the wire, then wrap the string around the coil several times and tie it.

Remove the U-shaped part of the core from its clamps and clamp the bottom of the core with two 1½ x 1½ x 1/8 x 10 in. angle-iron pieces with holes drilled at the ends to accept 3 in. machine bolts. Insert the bolts and tighten. Place the coils on the legs of the U-shaped piece and complete assembly of the core. Clamp the new assembled portion of the core with plywood and C-clamps. After several days, angle-iron clamps can be placed on the top of the core as on the bottom in place of the C-clamps. The phenolic board for the range switch can be mounted directly on one of these angle-iron pieces.



A complete bobbin ready to be placed on one of the core legs. Note the string used to tie down the end of the primary winding.

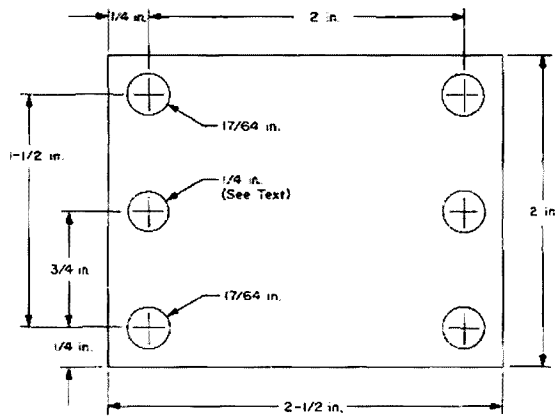


Fig. 5. Shunt clamp plate. Note; *(1) Two plates are required; (2) One of the holes marked for ¼ in. hole in one of the plates is drilled with a #6 drill and tapped with a ¼ x 20 tap. This will ride on the threaded rod which, when turned, moves the shunt in and out of the core.*

If the shunt has not as yet been made, it can be done at this time. It is made just like the core. It is a stack of 3 7/8 x 1½ in. iron plates varnished together; however, it is only made 2 in. high instead of 2¾ in. as the core proper. Two 3/8 in. plates, one aluminum and one phenolic, are drilled appropriately to clamp the shunt (Fig. 5). One of the guide holes in the aluminum plate is threaded (¼-20). A threaded rod along with a support rod on the opposite side of the shunt both support and move the shunt in and out of the core as the threaded rod is turned. Minimum current for a particular range is when the shunt is all the way inside the core and maximum is when the shunt is all the way out.

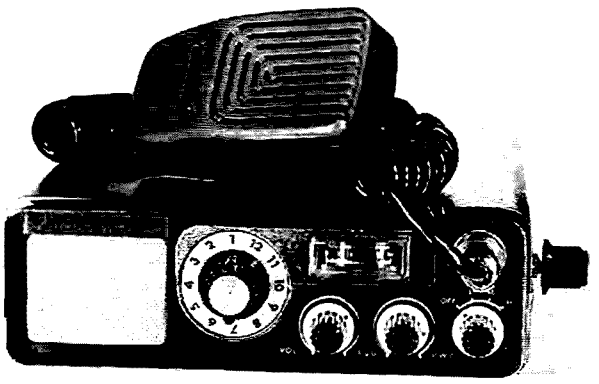
For the main switching deck, a piece of 3/8 in. phenolic board is used. Brass bolts are mounted in the board and serve as binding posts. When shorting wires are connected across the appropriate posts, a particular current range is selected.

Observe the wiring diagram. The arrangement of parts is not critical but try to keep the secondary leads as short as possible. The electrode and ground clamps as well as a face shield can be purchased from Sears, Roebuck. The welding cables, two 12 ft lengths of 4-gage stranded wire, can be purchased from any welding supply house.

At this time there are three of these welders in operation and functioning quite satisfactorily.

. . .W9IMS

WIN THE RIG OF THE MONTH!



ROSS&WHITE

The Ross & White two meter FM transceiver seems to have been overlooked by many amateurs because of its low price. Just take a look at some of the features of this rig and see what you think of it on a dollar for dollar basis as compared with the other available rigs.

If you are not yet on FM this is your golden opportunity to win a great FM rig free. Just follow the instructions below and enter the contest – there is nothing to buy – no obligation – it's absolutely free. If you are already on FM, then you can surely use this rig as a second (or a first, since the chances are that it will perform better than the one you are presently using) rig for the car – office – ham shack – trips – etc. You might even want to use it as a shoulder portable – it is ideal for this.

12 CHANNELS

While you may not need this many channels right now in your area (if you live outside of the larger cities, the east coast and midwest), the chances are that you will be needing them very soon, for FM is growing incredibly fast and the number of repeaters has doubled in just the last year.

WARPING CAPACITORS

Many of the lower priced transceivers economize by leaving out the warping capacitors on the receiver oscillator. The result is that you may well have a tough time hearing a repeater – or you will have to pay a premium for extremely accurate crystals to make up for the lack of capacitors. It costs extra to put these capacitors in the Ross & White – but they are there.

FRONT SPEAKER

Have you ever tried to hear a voice coming out of a two inch speaker which was aimed at your feet in the car? By the time you turn up the volume to where you can hear the speaker over the car noise the distortion is so bad that you can't understand what is being said. The speaker on the front panel of the Ross & White overcomes this problem – it is aimed right at your ears and you can hear everything clearly.

TEN WATTS

Most repeaters are designed to work with mobile rigs running ten watts output. This is exactly what you get with the Ross & White and it is certainly adequate. If you hunger for more, the most economical amplifiers are those designed for ten watts drive. The power switch on the front panel of the rig permits you to cut down to one watt or even 1/10th watt. This don't make much difference in the car – after all, what is ten watts to your car's power system? But this rig can be used with a small nicad pack as a shoulder portable and in this case the 1/10th watt position will be fine for most use – with the one watt available if the tenth watt doesn't cut the mustard – and the ten watts can be used for short periods when you are desperate. What other rig can do this?

VERY SMALL

Mounts anywhere – or goes under the arm for walkie-talkie use. One of the smallest 10 watt rigs available.

LOW INTERMOD

One of the big miseries in FM is interference from nearby or overly strong adjacent channel repeaters. The ceramic i-f filter in the Ross & White virtually overcomes this problem. This rig will perk perfectly in areas where other rigs are completely bombed out. If you are a newcomer to FM you may not appreciate the importance of this feature – if you are an old timer you wish you'd bought one of these rigs earlier.

S-METER

So who needs an S-meter? Once you try to get along without one on FM you know quickly who needs one. One way to know when you can or can't get into a repeater is to see how strong you are receiving it and you can only do this with an S-meter. When you hear more than one repeater on a channel you can only tell one from the other by signal strength. And without the meter how can you check various antennas of your own and others? The S-meter is very important.

TONE BURST

The prize Ross & White transceiver will include one of the excellent Ross & White tone burst units. This set normally sells for $280 with this tone burst unit built in and $240 without. The tone burst permits you to turn on repeaters which are matched to this type of entry – lets you operate tone burst functions on repeaters – etc.

MIKE-ETC

A matching mike and mounting bracket are included with the rig.

HOW TO WIN!

Take the entry blank from page 175 (or even a copy of it) to your local distributor and get him to initial it. If you spend anything during the visit have him mark that in – and should you be the winner that will be refunded in its entirety. Then send the entry blank to 73 so it can be in the hat for the next drawing. Extra entry blanks are available at the distributors listed on pages 176-177. No purchase is necessary, of course.

FULL REFUND

When you get your local dealer to initial your entry blank you should have him mark down at the same time the amount that you have spent with him during your visit. If your entry wins you will get a check from 73 Magazine for the amount of your purchases.

WHEN IS THE DRAWING

A drawing for the Rig Of The Month will be held on the 15th of each month. All entry blanks received before that date will be eligible for the prize rig.

The Ross & White transceiver drawing will be held for the following month's drawing. The drawing for the Ross & White will be December 15th – Merry Christmas!

G. W. Goodwin VE2DQ
283 27th Avenue
Deux Montagnes, Quebec
Canada

A SOLID SOLID STATE BREADBOARD

If transistorized projects are your "thing" then this article is for you.

Many times an interesting article appears in your favorite radio magazine or other publication, but some particular transistor or specific component is not readily available.

The junk box, however, yields something similar; or perhaps your friendly supplier can sell you something "just as good," not having exactly what you want in stock.

All too frequently this is the situation where we get into trouble if we make up a printed circuit board and carry on with our substituted components. Upon completion, we invariably find that our pet project leaves something to be desired, if it wasn't a complete waste of time.

Endeavoring to improve matters, we then continue merrily on our way unsoldering and substituting other condensers, resistors and what have you, until our project looks in sad shape indeed. So sad in fact, that we could cheerfully throw the whole thing out into the garbage can before the XYL gets her soft little pinkies on it first and does it for us.

P.C. boards are just not intended for this sort of treatment.

Yours truly has tried for many years to circumvent Murphy's Law which, in general, states that if anything can go wrong, it will. Personally I have found this law to be as inviolable to the constructor as George Simon Ohm's.

After some few failures of this sort – and being of a somewhat stubborn disposition by refusing to give up ham radio – I decided something better had to be done to improve the situation.

What is required primarily is something other than P.C. boards until satisfied that the circuit, with the substituted components, is working as intended.

All components should be easily accessible to facilitate any changes we deem necessary.

Once one is satisfied with the circuits operation and no further substitutions or alterations need to be made, then a P.C. board can be made up and all the bits and pieces transferred and transformed into the thing of beauty it was intended to be. The answer to this, of course, is the so-called "breadboard."

The vision of a breadboard brought to mind the nostalgic days of World War II when we were privileged to see a well-known commercial receiver in the process of development. Each resistor, bypass condenser and all the sundry bits and pieces that go to make up a receiver were individually mounted on a piece of Bakelite (remember that "low loss" stuff?) with a pair of plugs and a pair of jacks for easy changeability.

The whole receiver was spread out, with little room left over, on a bench measuring about 8 x 10 ft in the center of a room for easy access to any component which the design engineers wished to change.

Well, that is a solution, but hardly a practical one for the average ham. So what else is new?

An examination of the problem shows that our circuits require 7 or more basic connections, namely – emitter, base, collector, input, output, a common or ground and a "hot" line from the voltage source. A couple of neutral tie points should be added for convenience. These basic connections are always required so they should be made permanent fixtures.

Copper nails, screws, or what have you hammered into a piece of wood have some use, but again remembering Murphy's Law it will be apparent that the component to be changed is the one soldered under all the others. Not too convenient to say the least. What is required is a larger soldering area.

Also required is a means of holding variable condensers, potentiometers, phone jacks, etc., which is taken care of by the usual panel. The panel, however, should be kept as shallow as possible to facilitate wiring and any changing of components from the front rather than keep juggling the board around every time a change is necessary.

There should also be room on the board for easy mounting of such things as coils, crystals, or transformers as required for any individual project.

With the foregoing points in mind, the following simple but highly effective breadboard was constructed and has proved to be well worth the time and effort spent in construction.

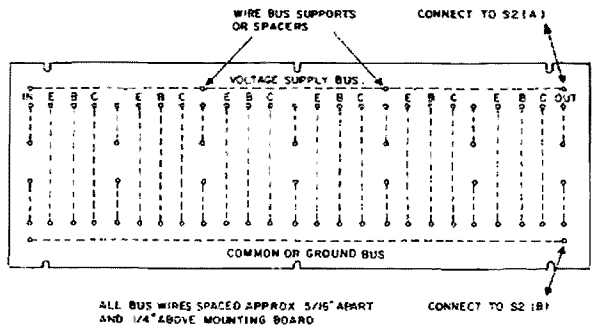


Fig. 1.

Representative dimensions are shown in the accompanying sketches but this, of course, is left to the discretion of the individual and his personal requirements (see Fig. 3).

The board shown has a capacity of six transistors but obviously only one or more need be used at any one time.

A suitable computer board, approximately 8½ x 3 in. stripped of any copper which will interfere with the operation of the assembled board is ideal.

It is not a requirement, however, and any piece of insulating material will do, even wood or masonite.

A series of holes are then drilled according to Fig. 1 to accommodate No. 14, or larger, solid tinned wire bus leads which are bent and fed into the appropriate holes, leaving each wire spaced about ¼ in. from the top of the board and approximately 5/16 in. apart. This spacing keeps the board clear of all resin residue which would build up in subsequent use if the wires were

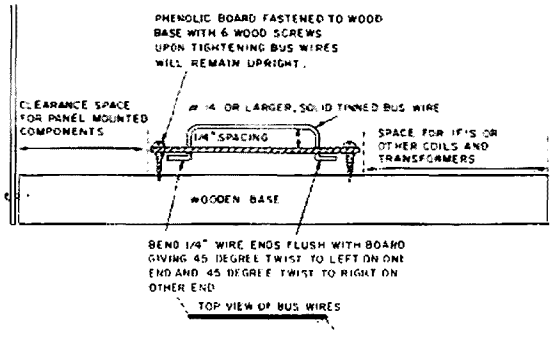


Fig. 2.

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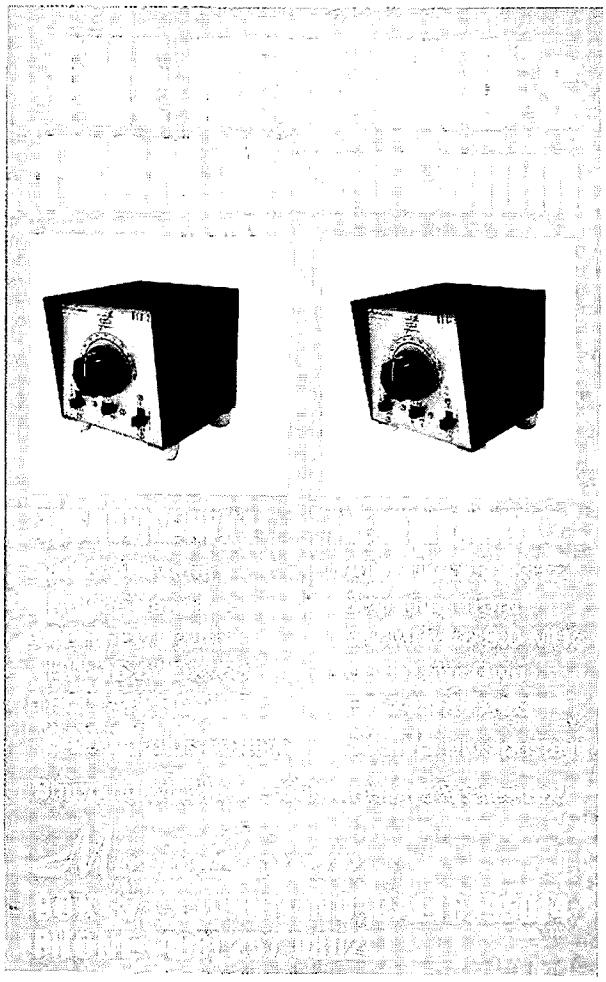
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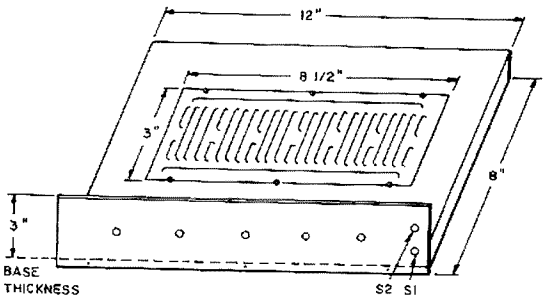


Fig. 3.

placed directly on top of the board. It also facilitates cleaning the bus wires of excess solder buildup when it is only necessary to tilt the board up, resting on its panel and run a hot iron along each wire when it will run off, leaving everything nice and clear again, ready for the next project.

If you use a computer board and have any usable copper underneath each hole where the ends of the bus wires project, you can anchor each wire by soldering and snipping off any excess wire.

If not, an alternate means, and just as satisfactory, is to have about ¼ in. of bus wire project through each hole and then bend it toward the outside edge of the board and flush with the bottom. Each end is then given a slight twist of about 45 degrees to the left for all those wires terminating at one edge of the board and to the right, or opposite direction, for those terminating at the opposite edge. See Fig. 2.

This opposite twisting is necessary to prevent the bus wires from falling against each other when fastened to the base, holding them rigidly in place. Don't worry about it at this point if all the wires are flopping around in the breeze; just make sure they won't touch each other when mounted and fastened down on the base.

Our breadboard is now required for the base and as the name implies, one can actually be used just as baking tins can be used for chassis. However, any suitable piece of lumber on hand can be used either finished or unfinished, painted or unpainted, depending on your aesthetic taste. If you are a stubborn type and insist on using one of the XYL's baking tins, don't forget to insulate the bus bar board from it first before fastening the two together.

The actual size of the base is not important, but it is recommended that it be 2 or 3 in. larger around each edge of the bus board and something about 12 x 8 in. would do fine.

The bus board is then centered onto the base with all the bus wires in place and fastened down with six wood screws (Fig. 3.)

A shallow panel is now required which can be aluminum, thin plywood or what have you, drilled with a series of 3/8 in. mounting holes for variable condensers, pots, etc., which may be required to be used later when trying out some circuit. A small speaker or meter should also be considered at this point. This is left to the discretion of one's individual requirements. The panel runs the length of the base and is fastened to the edge of the base with a couple of wood screws.

Two toggle switches are an integral part of the board. They are mounted permanently on the right hand side of the panel and wired as shown in Fig. 4. S1, a DPST, controls the on-off function, and S2, a DPDT, switches or reverses the power supply, be it battery or variable voltage power supply, depending upon whether a PNP or NPN transistor is being used.

A battery snap connects to the on-off switch, S1, for convenience in swtching to different battery holders and voltages as required, for those not in possession of variable voltage power supplies and who must use batteries. If batteries are used, a suitable clamp should be incorporated to hold the battery down. This is easily fashioned from a piece of scrap aluminum,

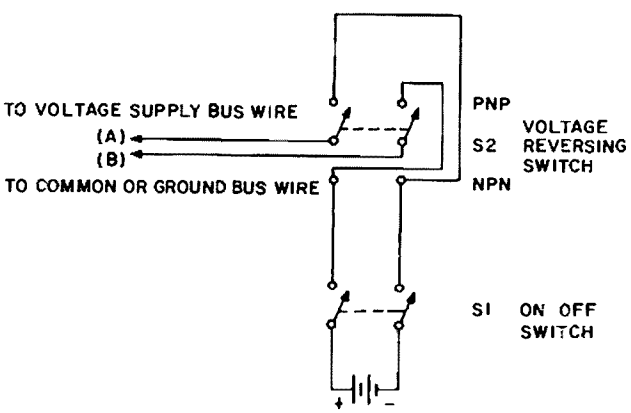


Fig. 4.

wire, or even an elastic band and should be mounted on the wood base or panel, adjacent to the on-off switch, S1.

For those with variable voltage power supplies S1 is probably not required and can be connected to the voltage reversing switch, S2, directly through a plug and jack arrangement. It could even be made an integral part of the board if desired.

In using the board any components such as coils, transformers, etc., not provided for on the panel are conveniently placed on the base adjacent to the bus wires to which they connect. In most cases it will not be necessary to fasten them down, but this can be done with wood screws if required.

As for the transistors, they can either be placed in sockets and wired to the appropriate bus wires or soldered directly onto each bus wire if the leads are long enough, whichever one prefers.

Fixed resistors and condensers are simply soldered onto each bus wire as required without fitting or cutting off excess lead lengths, and no attempt is made to have the circuit look pretty at this point. If we wanted it to look pretty, we could tie a pink ribbon in it or something – whatever your favorite color.

If a number of connections terminate at any one bus wire, spread them out rather than have them sit one on top of the other under one blob of solder. If it is then necessary to unsolder a component or lead, the other half dozen or so won't come off too.

By now some purists are screaming like mad about efficiency and losses and making rude remarks. Don't you believe it, or if you do, forget it temporarily, as we are only interested in getting a circuit to percolate properly at this point in the overall scheme of things. The efficiency can be found with this circuit board first and then built into our finished project – or can it?

Upon reflection, Murphy's Law also states that while the breadboard model functions perfectly, the finished product won't. Oh well, at least you will have tried before getting out of the game altogether.

. . .VE2DQ

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DID YOU EVER WANT YOUR OWN COMPUTER ?

The objective of this article is to provide a ham with enough information to allow him to build a pretty nice minicomputer. An alternative to building your own is at least understanding what makes the brain machine tick. This means if you don't meet the qualifications of a computer builder, you can buy yourself a good used computer and understand enough of its operation to put it to work for you. (Hint, do not trade the XYL in on a used computer – the computer would undoubtedly make a more intelligent companion, but it would have a heck of a time washing your socks.)

The basic requirements for being a computer-builder are; of course, patience, clean living, a large state-of-the-art goodie box, and/or lots of money. You must also have an understanding wife and kids because this project will take you about as long as building a good receiver. Seriously, the amazing supply of cheap integrated circuits available will keep the overall cost low, and will save you considerable time in constructing and designing your computer. Anyway, if you want to build, or have the interest to find out the "why" of the computer . . .here we go!

The Basic Machine

The major circuits making up any computer are shown in Fig. 1. The five basic circuits are the input, output, arithmetic, storage and control circuits. Each one of these circuits is actually made up of many smaller sub-circuits which you will be concerned with building. The five major circuits work together to form a machine capable of accomplishing tasks that are described for it by human operators. The input and output circuits (I/O), provide the means for data signals to enter and leave the computer. The arithmetic circuit performs arithmetic operations on the data signals within the computer. The storage circuits act as the computer memory to store selected data. The control circuits control all the operations within the computer: they control when data is input and output, what and where data is stored, what arithmetic operations are performed, and in general, they keep command of the whole machine. The five basic circuits of the computer are made up of actual electronic components and as such are called the hardware of the computer. Ultimately, all the operations in the computer's hardware are controlled by a bunch of data signals called "words" that make up the computer software.

The software shown in Fig. 1 actually is a group of logic 1 and logic 0's (ground levels and voltage levels) that control the computer through the control circuits in the hardware.

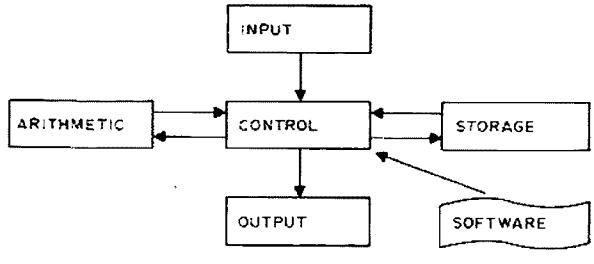


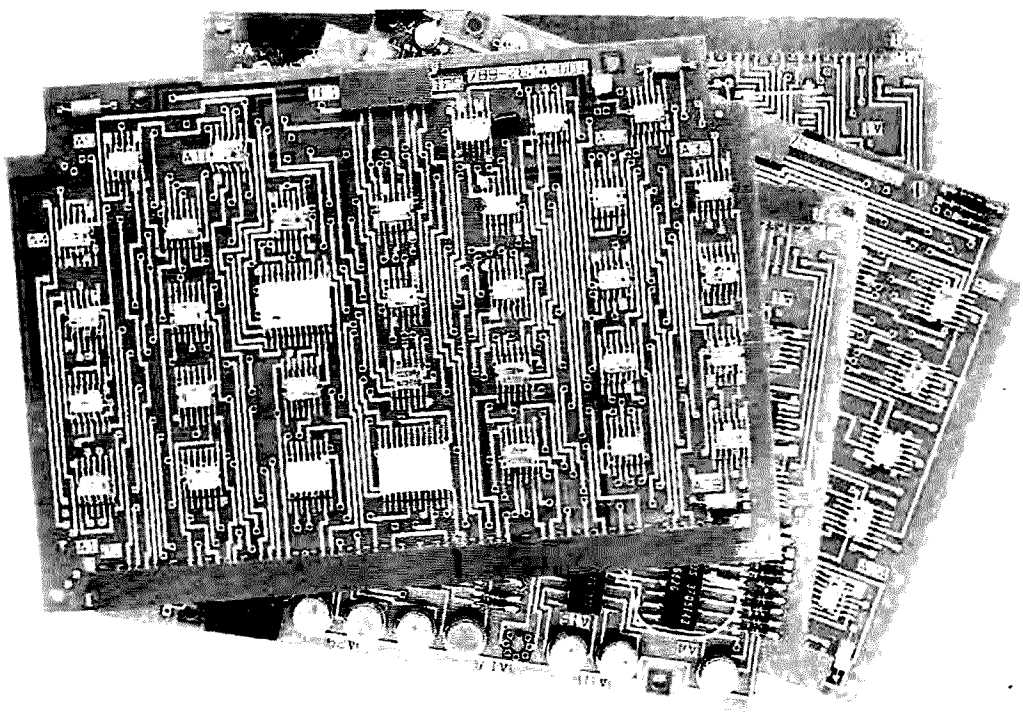
Fig. 1. Typical computer. This is the classical configuration common to all computers. The "software" is actually data (words) that control the operations in the computer via the control circuits. Actual circuits in the computer are the "hardware."

The software allows you to program the computer to carry out desired tasks such as calculating antenna length, etc. We must merely know how to arrange the logic 1 and logic 0 bits into groups so we can talk the machine language. Of course, if the computer is big enough, we can build in an interpreter to allow us to talk to the machine in English. (One such interpreter is the famous FORTRAN COMPILER that I'm sure you've heard of before. FORTRAN stands for FORmula TRANslation; this means formulas are translated to the machine language.) You will have to go to the trouble of learning to use our machine's language unless you want to write a compiler for it after you've built it. Actually, you will merely write down the words that perform a task in your machine and use this as a reference for programming. (Even the pros use a "program reference manual" to translate, since languages get more than just a little complex!) Well, now that we have some background, let's consider building.

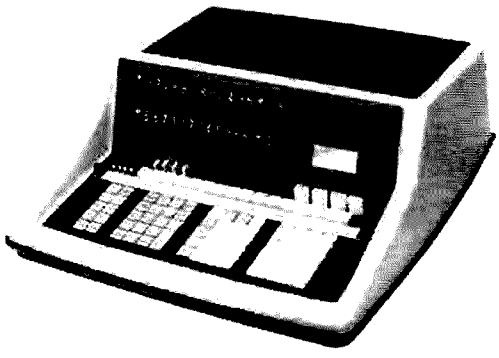
Major Construction Considerations

Armed with the basics of computer operation let's consider some of the factors that will war against our construction. Probably the major factor to consider is packaging. You may not want your little jewel to take up half your hamshack or most of your bedroom! Consider some of the little monsters shown in the photos. These computers range from everything from a job that is contained on four circuit cards to a magnificent machine that would consume my house or yours! Consider the approximate size of your proposed machine. Don't limit yourself to a 3x5x7 minibox, but don't envision a monster consuming four or five 7-foot racks either. You'll want the machine large enough to be easy to service, but small enough to move across the room without calling in Allied Van Lines. Don't buy a box and then try to fit in the components. First get a feel for how large and how many circuit cards there will be, then buy a pretty box.

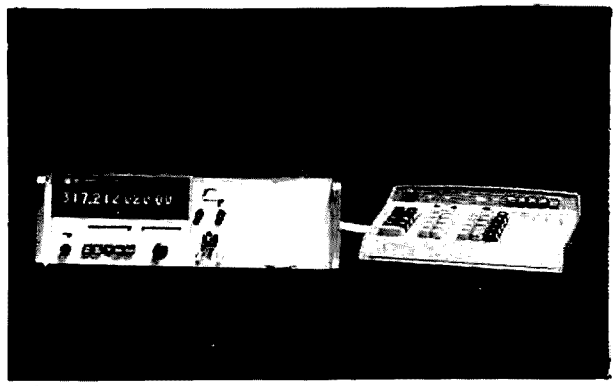
Speed and size of memory will become primary considerations in planning your machine. Read this whole article first, then figure out how much memory you want, what kind of speed to shoot for, etc. Speed and size of storage will both tend to be factors in the size of your machine. Higher speed generally means smaller circuits, shorter interconnecting wiring, etc. and a general overall reduction in size. Larger memory generally means more circuits and a bigger machine.



Collin's Radio company's Micro-Minicomputer. The mini is used throughout this article as a reference to describe computer circuits. This mini has a 16 bit word and a 4096 word instruction read only memory.



The Wang 700A -- a powerful desk top calculator with 8,192 bits of memory organized as 120 storage registers. Programs for the calculator are stored on magnetic tape cassettes.



The Hewlett Packard Computing counter performs sophisticated analysis and doubles as a desk top calculator with the counter input serving as one of the variables.

Price would undoubtedly be a consideration. For many of us, price may be the first consideration! This could possibly be the main reason you would like to build your computer instead of buying. Anyway, here's the scoop; a fairly decent used computer will generally cost you about $10,000. One can buy a little minicomputer from one of the electronics companies for about $3,000. My estimate for the cost of a simple unit that every ham should have in his shack places the price under $200! If you have a full junkbox or you work for a company that offers employee discounts and surplus component sales, you can cut this price considerably. It's obvious, however, that you will have to spend some money on this project to obtain some specialized parts.

Parts for the project are readily available on the discount semi-conductor market or as aforementioned discounts or company stock surpluses. You will definitely have to buy some of the parts at regular prices unless you want to make the major circuits from samll-scale integrated circuits rather than from large and medium-scale integrated circuits. You can fabricate any of the circuits from discrete components. Keep in mind that, unless you have the parts on hand, building each flip-flop, etc. will increase the cost of the project, and using discrete components will definitely increase package size.

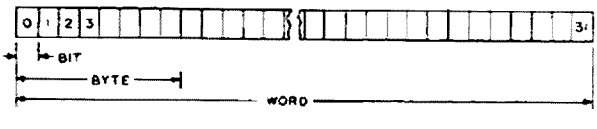


Fig. 2. Large computer, typical word. The computer word is broken down into data "bytes" as explained in the text. The bytes are further broken into their respective data "bits." The "home brew" computer is 'byte oriented" to the extent that registers are 8-bits (one byte, or character, long).

Circuit Details

Now let's look at the individual circuits of the computer and see if we can point out any other construction problems. When you begin to understand how the circuits within the computer function, you can more fully understand the overall operation of the machine. First, we will give a basic description of the circuits, then go into the details.

Input/Output

The input/output circuits (I/O) carry the data signals to and from the computer and the peripheral device. In most ham shacks, the peripheral will be the shack's teletype machine. The input/output circuits must provide buffering for the data signals to and from the computer. To buffer data, you must simply store enough of the data to allow the computer to take data when it is ready. If the data signals entered the computer before the computer needed the data, the result would be a very confused computer and an even more confused operator.

In order to buffer, the input/output circuits will have to store at least one complete teletype character. In fact just one TTY character would be called a "byte" (pronounced bīt) in computer language, because the byte is the lowest number of data bits capable of storing a complete character. A data word would be a group of bytes just

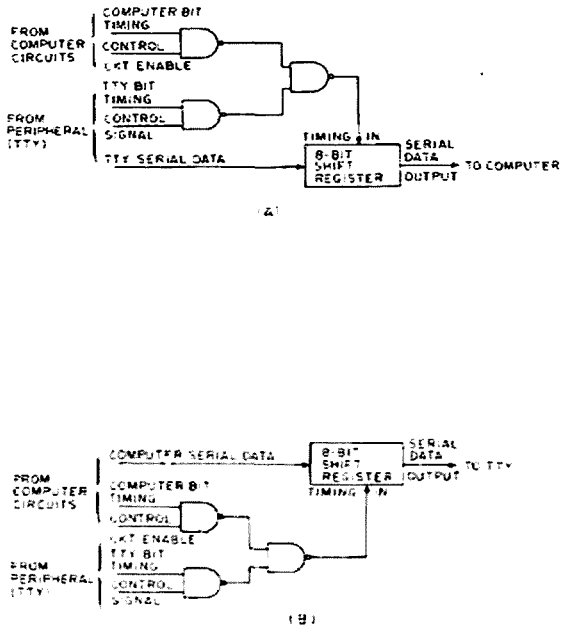


Fig. 3(A & B). I/O Circuits. Fig. 3A shows the computer input circuits. Data from the TTY enters the register under TTY control. This data is stored until "computer timing" drives it from the register under program control (control CKT enable).
Fig. 3B shows the computer output signal. This time the computer enters and stores data and the TTY removes the data at TTY timing rates.

as a byte is a group of bits. The word can be any number of bytes; in most computers a word contains at least four bytes as shown in Fig. 2. In our "mini" a word will contain only one byte.

You must make the I/O circuits in your computer capable of storing a data word. Since a word and a byte are the same in this machine, the word will be 8 bits long. Thus your computer can affectionately be called an "8-bit machine." Now it is obvious that we must devise a circuit that is capable of storing 8-bits of data. The data must load into the input circuit at a timing rate determined by the peripheral (TTY), and the data must be taken out at a timing rate determined by the computer. The opposite must happen in the output circuits, that is, the data must load in at a computer rate and read out to the peripheral at a peripheral rate. Take a look at the circuit shown in Fig. 3. This is the input circuit to a commercially produced minicomputer altered somewhat to make it compatible to our requirements.

Notice how the TTY CONTROL signal controls the entry of the TTY timing signal into the gate which clocks the register. The TTY CONTROL signal could be generated by a circuit which detects the depression of a key on the TTY. The TTY TIMING signal is one that occurs at TTY bit times and each bit of the TTY signal is clocked into the machine. When the STRF (store) signal goes high, the computer's internal timing reads out the signal stored in the byte register. This signal is routed to the control circuits (Fig. 1) and the control circuit will decide what to do with it, i.e.; whether to store the signal, process it in the arithmetic circuits, or to ship it on out to the output circuits. The selection of what's done with the signal depends on the program of the "software" shown in Fig. 1.

Arithmetic Circuits

The arithmetic circuit provides arithmetic and logical operations on the data signals within the computer. Upon command of the control circuits, the arithmetic section of the computer can ADD Logical OR, Exclusive OR, or Logican AND any two data signals. Some computers can multiply or divide directly in the arithmetic circuits, our computer will not offer this "hardware multiply/divide." If you want to multiply, you'll have to add again and again. If you want to divide, you are going to have to learn two's complementing and take it from there.

The arithmetic circuit mostly consists of simple steering of data signals through the gates that will perform the appropriate operation on the data. Figure 4 shows the arithmetic circuit recommended for our computer. It is simple, straightforward, and easy to troubleshoot. Probably the main thing in its favor is that it is cheap! The inputs marked CONTROL INPUT come from the control circuits. These inputs are ultimately controlled by the program (or software).

If you use this circuit, you should be able to contain the entire arithmetic circuit on one card. This will greatly aid you in troubleshooting and construction. The adder can be most any full adder which is compatible with the logic you use. If you are using RTL or compatible TTL you might try the MC796P for only a shade over $5.00.

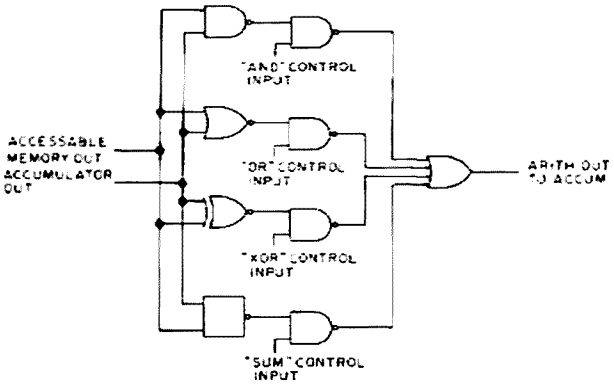


Fig. 4. Arithmetic circuits. The output of the workable storage memory (accessible memory), and the accumulator are combined in AND, OR, EXCLUSIVE OR, or ADDER. The gated data outputs are chosen by the various control inputs from the control circuits. These control signals are generated in the computer program.

This is much cheaper than you can build one yourself. Since this particular unit is a Dual-full adder, you will have a spare: this is a good policy because it's just like buying an extra fuse. By the way, if you want to hardware subtract, you can add the MC796P; two full subtracters (same price as the 796). Of course, there are many adders and subtracters on the market. Be sure to select one that is compatible with the type of logic you are using, i.e.; TTL, RTL, ECL, etc.).

Storage Circuits

There actually are many storage circuits within the computer. These circuits store instructions or data in the computer and allow the computer to use the data or instructions at some later time. Your log is a "storage area" and stores information regarding your past QSO's. One example of a storage circuit is the input/output circuits already mentioned. The data input (or output) is stored until the computer (or peripheral) is ready to use it.

Storage circuits within the computer are usually classified to their degree of importance. In reality, one is just as important as the other in overall operation, but we order their importance in the same way that we consider the fuse less important than the overall transmitter. Yet we know that the fuse can mean the difference between the transmitter operating or not.

In our small machine, we have three levels of storage or memory: main memory which stores the software and the programs that make the computer carry out a desired function; workable memory which allows for semi-permanent storage of data while an operation is performed; and temporary memory which includes all temporary storage such as the registers in the input/output circuits. First, look at some main memory systems and decide on some version to use in our computer.

Main Memory

The main memory must store the computer program along with the software (called the operating system) that tells the computer when to do what thing. The simplest main memory would be a shift register that is fed from the peripheral with the program, and then stores the instructions until the computer has need to read out an instruction. Assuming your computer was to have a limited number of instruction words, this shift register memory would probably work rather well. However, keep in mind that the computer does things in very minute steps and you will see that you must be able to insert many instructions into the machine to

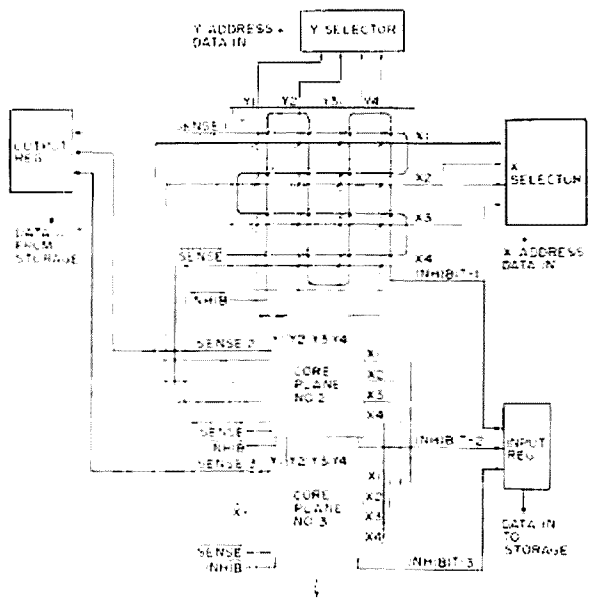


Fig. 5. Core-Main memory. This core memory will store 3-bit instruction words or data words. Instruction words are stored in "protected" areas of core. Workable areas of core will be used as temporary storage for program-selected data. These areas of core work as 'accessible memory."

perform a relatively simple task. This would mean many shift registers and lots of money. Enter, the magnetic core memory. The magnetic core memory saves the day for us. Cores are cheap, reliable, and easily obtained. They have their problems though, the cores are extremely small and are very sensitive to temperature changes and not normally as small or as fast as shift register memories. Core memories basically consist of a matrix of magnetic cores. The cores are addressed by selecting X and Y coordinates. The X and Y lines are pulsed and the cores selected and magnetized. Cores magnetized in one direction equal a logic 1 and cores magnetized in the opposite direction equal logic 0.

Figure 5 shows a section of a simple core memory. The currents in the X and Y lines are called the half-select currents. Two times the current flowing in either the X or Y lines is required to saturate a core. With half the select current in each of the X and Y lines, only the cores that appear at the intersection of the X and Y lines will be saturated. All the X and Y lines feed all core planes as shown in Fig. 6. A specified X and Y address will find the intersection of the same core position in each plane. The two half currents

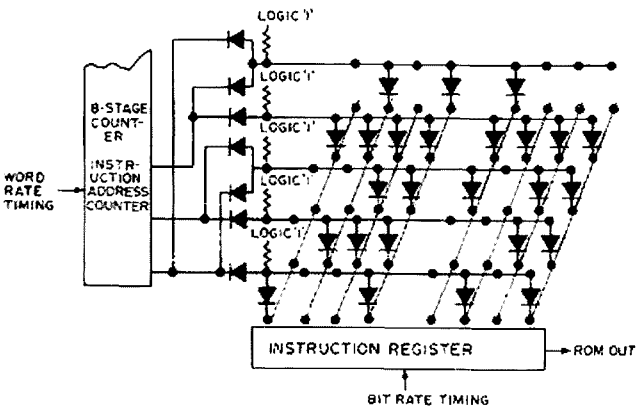


Fig. 6. 256 Bit rom (partial drawing). Contrasting the core memory, the read only memory (rom) provides instruction outputs. The instruction word is formed by the diodes. Where a diode is present a logic 1 will be stored in the instruction register. Note that if you are using an instruction register which is clamped by its SET input you will have to add a pulse-forming network on the SET input of each stage. Also if your register needs logic "0" to set, reverse your logic. The diodes on the 8-stage counter insure a "word 1,2,3,4,5. . " count.

(X and Y) will switch the core in each plane to logic 1. Note that for any one X and Y drive line, the same position in all three core planes will store logic 1. The inhibit signal causes the selected core to store logic 0.

To read from the cores, the X and Y read addresses are chosen, and a half current in each (opposite of the write current) switches the addressed cores in each plane to logic 0. If the core is presently a logic 1, the sense line for that core plane will feel an output pulse. If the core is at logic 0, there will be no output.

The read action causes the core to switch and the stored data changes. This is called a "destructive read" because the stored data is lost. To compensate, the computer rewrites the data back into the core, while the X and Y addresses remain the same. Thus, core memories have a "write after" cycle to keep data from being completely lost.

Your problem as the builder, is to incorporate the write after read cycle and the bi-directional drive currents to the core. The write after read cycle can be hardwired into the machines timing circuits. Integrated circuits can be had that will supply the bi-directional drive currents for the cores.

Finding the cores is actually easy. One can obtain 14x16 bit core planes in a 5-plane stack from Herbach and Rademan Inc., 401 East Erie Avenue, Philadelphia, Pa. 19134. The price for an IBM surplus stack is only $24.95. One of these little jewels would provide a dandy start for your computer, and you could add a stack as you could afford it.

There is one more type of main memory you might consider; the read-only memory. The read only memory can be a simple, diode matrix arranged to form instruction and data words when pulsed. It would take a lot of diodes to work (maximum of eight per instruction). For 8-bit instructions and about 144 instructions in all, it could take a maximum of 1152 diodes! Sounds bad, but you can buy 1000, 1N34's (which should be OK at our slow speeds) for only $19.00 from B-A. If you decide to go the read-only memory (rom) route, you will have to wait till you decide on some control circuits before you build the rom. This is because you program the thing when you build it

and you'll have to know the capabilities of the machine.

The disadvantage to the rom is that it reads only. In order to change the program, you'll have to rewire, or make another rom. The average ham might go with the rom, because it will be cheaper in the long run since there are no special circuits or two-directional currents to switch. By building several rom's on separate cards, you could change programs merely by swapping rom's. Later, you could add a core memory, or even a solid-state job if you wanted. Figure 6 shows a portion of a typical rom. This will give you an idea of what you'll need and the control circuits will tell you exactly how to organize the memory.

Workable Memory

My only recommendation for a workable memory would be a shift register. Of course, if you use a core memory, you can merely use portions of the core memory for workable memory. Several shift registers would be arranged to be accessed as data registers. These registers would be designated "data register 1,2,. . .etc." Figure 7 shows the workable or "accessible" memory that is used in the example computer. Access to the registers in the accessible memory is provided by the control circuits and thus, the computer program.

The accessible memory will be used to store data from the main memory input signals, data to be output, or the combination of signals from the arithmetic circuits. The registers can feed data from their output back to the input to allow us to rotate, or move the data within the register by any number of bits as selected by the program or to save data signals.

Temporary Memory

The temporary memory will provide temporary storage of data until the data can be transferred to other registers or circuits within the computer. An example of a temporary memory is the register in the I/O circuits. Another is the Accumulator Register in the example computer. This register merely accumulates data from other sources for one operation of the machine. The accumulator is merely a byte-long register and is only shown in the block diagram, Fig. 14, because of its simplicity.

That is about all that can be said about memory for your machine. It is your decision as to whether to use a core memory or rom for main storage. Keep in mind that in the example computer herein, an rom is used. Lets go now to where the circuit hardware first meets the software – the control circuits.

Control Circuits

The control circuits actually make the rest of the computer operate. This is where the commands that you insert in the program are decoded and changed to enable signals that control other parts of the computer. Figure 8 is a block diagram depicting the control circuits and their function. Note that circuits within the computer are input and output selectors that route data signals to and from various registers within the machine.

The hub of the control circuits is the instruction decoder. Instruction inputs from the main memory enter the instruction decoder and become commands to the computer's gating circuits. The gating circuits are: the accumulator input selector; accessible memory input selector; accessible memory/accumulator output selector; arithmetic circuit input selector; input and output circuits; and the timing circuits. All the gating circuits are similar to the gating

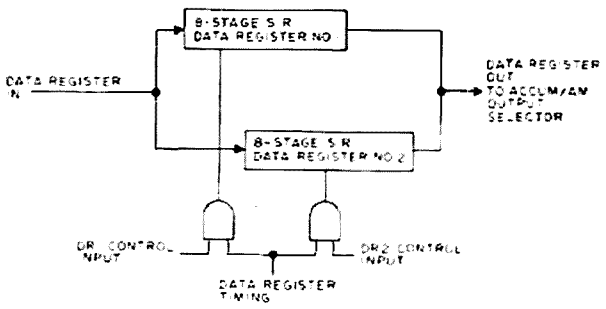


Fig. 7. Accessible memory. The accessible memory provides workable storage when rom is used. It also provides temporary storage if you use main core memory. The accessible memory is made up of two 8-stage shift registers (DR1 & DR2). Inputs and outputs to these "data registers" are parallel. The data registers are selected by the program via the control inputs. The control inputs route timing to the selected register.

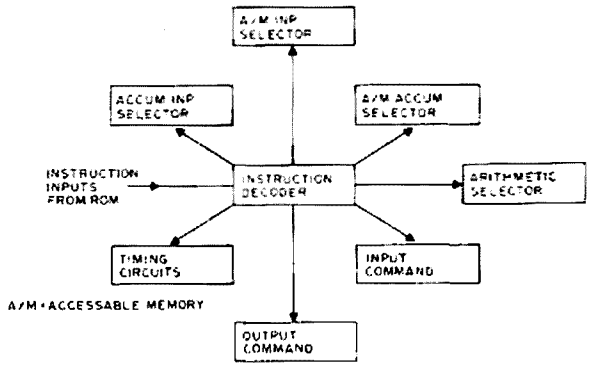


Fig. 8. Control circuits. The control circuits interface the human programmer and the machine. The instruction words from the rom are programmed by the programmer. These words are decoded by the instruction decoder. The many outputs from the instruction decoder go out to control data to/from registers, operations in the arithmetic circuits, data to/from peripherals, etc.

circuits in the arithmetic section of the computer. That is, the instruction decoder supplies the enables and the gating circuits do the routing of the data (see Fig. 10).

The instruction decoder is made up of two major portions, the instruction storage register, and the decoding circuits. For clarity, Fig. 9 shows only a portion of the instruction decoder (the other part is in Fig. 10). The instruction reads in from the main memory and is stored in the instruction storage register. The parallel output of the instruction storage register is decoded in the instruction decoder. The outputs from the instruction decoder are the logic 1 or logic 0 levels that control the computer circuits.

It is the input from the Main Memory (rom in the figure) that determines the actions that take place in the computer. The arrangement of the logic 1's and 0's in the instruction word, control all circuits within the computer. Remember, core or shift register memories have the program inserted by the operator at the same time the machine is programmed. With read-only memory, the program is inserted when the rom is wired.

The instruction decoder is made up of two "one of four" and one "one of 16" decoders and their associated gates. The gates shown in the diagram are not hardware gates. The gates are the logic symbols and you will have to use combinations of AND and OR gates in order to achieve these logic functions. Let's look over the various circuits in the decoder and find their functions within the machine. At this point, we will look at the hardware and the software in such a way that you may have trouble telling which is which. Just remember that the hardware pertains to the circuits doing the decoding and the software is the word being decoded.

The first two bits from the storage register are decoded by a one-of-four decoder. This means that the four combinations of the two input bits are decoded to achieve one of four possible outputs at any one time. Thus a 0,0 on the input will drive the ACCUM output to a logic 1 (note: you will need to invert to get this from an IC). This selects to send the output of the accumulator to some selected circuit in the computer. A 0,1 input (decimal 1) enables the output called DR1, this is Data Register #1 in the two-register accessible memory. Likewise, a 1,0 (decimal 2) enables the output which controls Data Register #2. The 1,1 output (decimal 3) is not used.

The next two bits of the instruction word control three things: rotation of data, rom output to accumulator, or data register end

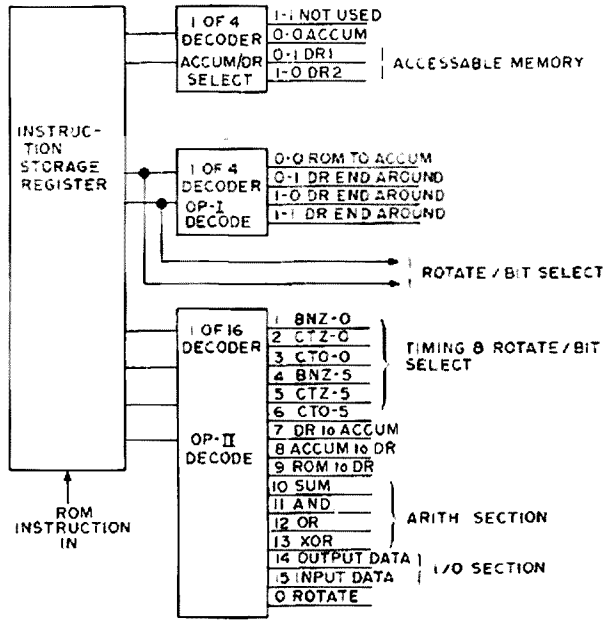


Fig. 9. Instruction decoder (simplified). The instruction decoder provides outputs which control the computer functions. The one of four and one of 16 decoders may be fabricated or may be purchased as MSI circuits from Fairchild.

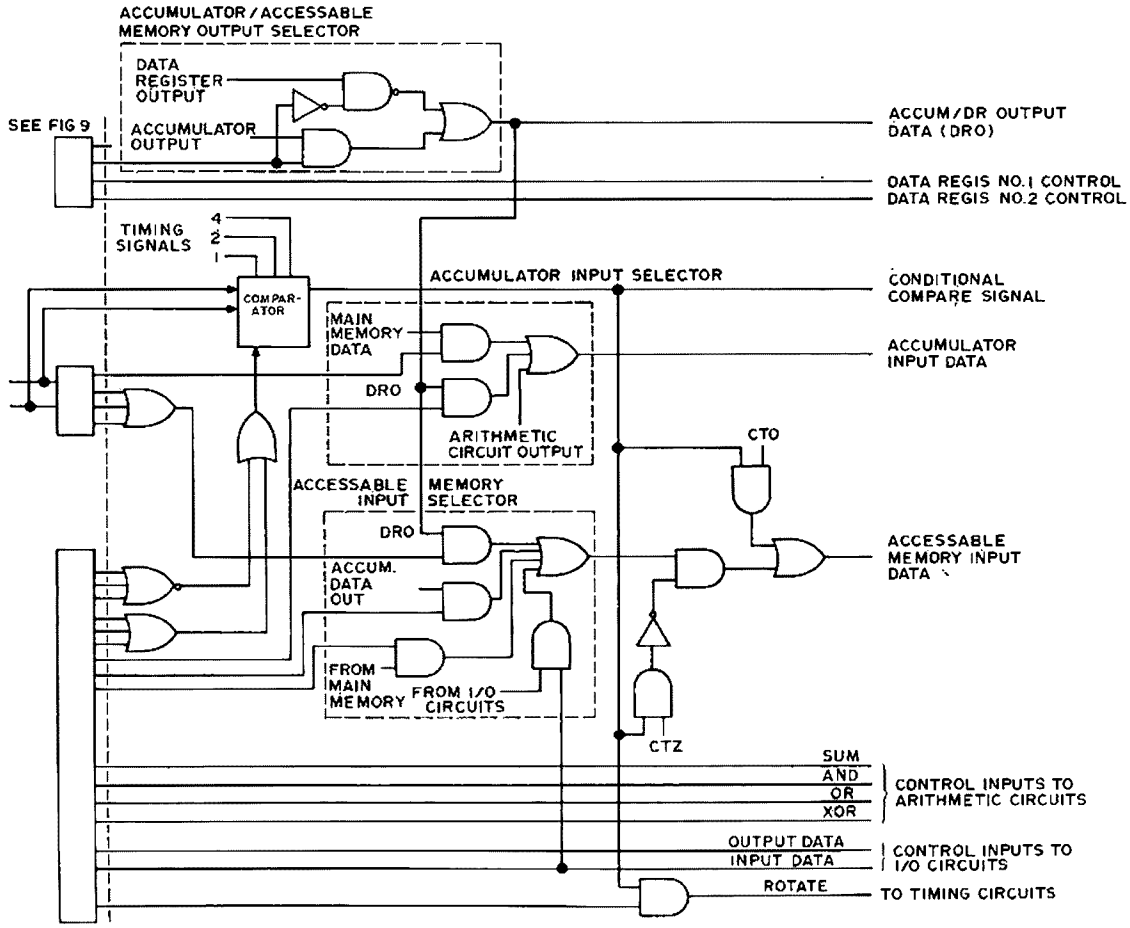


Fig. 10. Instruction decoder. The instructions (Fig. 9) cause outputs from the circuits pictured here. These outputs are switched data signals or control signals as shown.

around. The next four bits of the instruction word actually control operations within the computer. From the block diagram, Fig. 8, these outputs feed the arithmetic operations circuits, accumulator register inputs, data register inputs, and input/output control circuits.

Figure 10 shows the remainder of the control circuits. Primarily the rest of the circuits merely gate the various outputs from the instruction decoder. These circuits should easily fit on their own, separate printed circuit card. Since there will be many actual data signals routed through this card, take care to isolate each data signal with a power or ground lead on the card if possible. This should eliminate many problems caused by feed through of data.

Actually, the operation of these circuits is obvious by taking a close look at the logic. For instance, the ACCUM/AM OTPUT SELECTOR (accumulator or accessible memory output selector) uses the first output from a one-of-four decoder to control the data output called DRO (data register out). When the control signal from the decoder is a logical, the AND gate is enabled and ACCUM (accumulator) output data is routed out to become DRO. Under the opposite condition, the AND gate is disabled and the inverter allows the DRO signal to be formed by the data register output.

A little explanation is necessary to understand the purpose of the comparator. The comparator works on inputs from the instruction decoder and the timing circuits to provide an output that is a function of time. When the instruction decoder decodes a binary number, this number (between 0 and 7) is applied to the comparator. The first two bits of the three come from the 3rd and 4th output of the instruction storage register. The third bit comes from the one of 16 decoder and indicates whether a branch or clear instruction is greater or less then 4. Note: since there is no third bit in a rotate condition, you can rotate data only a maximum of three bits per computer operation.

When the timing signals enter the comparator match the binary number on the other three inputs, the comparator will have an output. This output will be used to check a data bit (branch), change a bit to 1 or 0 (clear), or move the data within the accessible memory (rotate).

Be sure to study this part of the computer carefully. These circuits are your interface with the machine. When you want the computer to do something (other than just sit there, of course) you must tell it to happen in the control circuits. Thus the control circuits will determine the word structures that you use in writing a program (and wiring the rom, if you go that route).

Timing

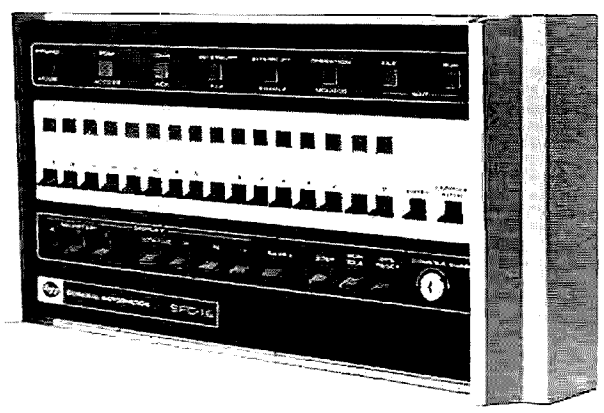
Timing for the computer is very important. Timing allows the computer to operate properly by controlling the sequence of events that take place in the computer. Various timing signals must be provided, some of which are; word and bit times, and cycle times. Word and bit times are self explanatory; bit times are the fastest, and word times are made up of a number of bit times (8, in this machine). Cycle times are a little weirder, and may require some further explanation.

Your computer will operate in up to three cycle times: two, normally, with a third added if certain conditions are met. The two main times are the instruction read and the instruction execute cycles. During the instruction read cycle, the instruct on word reads from the rom and is decoded. During the instruction execute cycle, the decoded instruction is executed, or performed. For instance, the instruction read cycle may bring in an instruction that tells the computer to ADD two signals. The two signals will then be added in the instruction execute cycle.

If an instruction is a "branch" you generate a new timing cycle. If the decision to branch is positive, the rom puts out a literal word which loads into the accumulator. Then the word is dropped into the instruction address counter. Thus the next computer instruction comes from the rom at the place specified in the literal "branch to" address.

In case you haven't already guessed, the three cycles must be at least a word long. In fact, for insurance, and because this computer isn't going to be the fastest thing on earth, the cycles will be two words long. The actual operations will take place on the first word and the circuits can more or less "settle in" during the last word. This feature will also allow you to increase your machine's capacity to a 16-bit word sometime with little modification to the timing circuits.

You'll have to be fairly careful in laying out the timing circuits. You should come out all right if you remember to follow the rules on IC spec sheets, such as tying all unused J and K's to logic 1. Board layout won't really be critical unless you decide to make your machine run at high frequencies. Try 100 kHz basic oscillator frequency. Do decouple the power leads into the card and tie them to the front of your power bus. These measures will help keep the timing on



General Automation's minicomputer with a 16 bit word and a 4K expandable memory, does operations less than 1 ms.



The IBM 360/195 – the largest computer in IBM's line. This machine can process an instruction in only 54 nonoseconds.

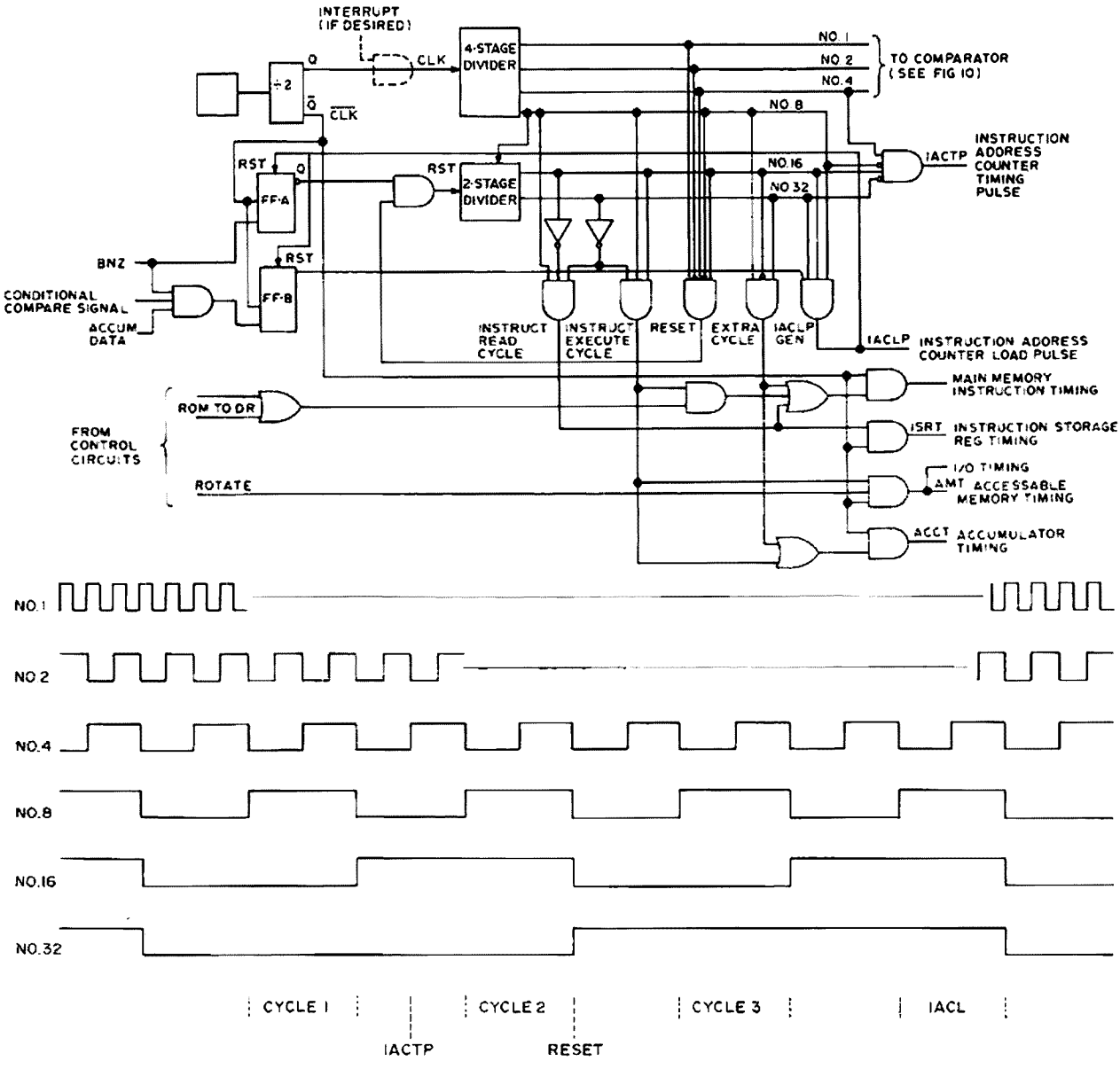


Fig. 11. Timing circuits. These circuits provide timing to the various computer circuits at the proper sequence. When the command is a conditioned branch, and the condition is positive FF-A forms a new timing cycle (see text).

the timing card only, except where you run a wire out.

The circuits shown in Fig. 11 are based on operational circuits. Stick closely to the recommended logic and you should have your timing circuits working a lot faster. If you have good working timing circuits, you will have your computer up and running in a lot shorter time.

Roughly what's going on in Fig. 11 is that timing is generated by the 100 kHz oscillator and divided by the frequency dividers, down to word length. The word length outputs are gates to form the cycle signals. The timing diagram in Fig. 11 explains the operation of the circuits overall.

The 4-stage divider output signals are applied to the comparator in the control circuits to provide a time variable signal. These signals are also used in combination with the 2-stage counter outputs to provide the cycle timing intervals. Notice that if the reset output is not inhibited at the input, it resets the 2-stage counter after the instruc-

tion execute cycle. A branch command cuases flip-flop A to inhibit the reset and thus a 3rd timing cycle begins.

Also during the branch command, the IACLP (instruction address counter load pulse) is generated. This signal loads the output of the accumulator into the instruction address counter if the branch decision is positive. Thus because of the action of flip-flop B, the computer will "skip" as many steps in the program as was determined necessary by the programmer.

The IACTP is the instruction address counter timing pulse and it occurs just before the instruction execute cycle so the next instruction will read from the next memory position. The pulse was placed here so that if the instruction word said the next word was a literal to be placed somewhere in memory, the word could read in during the instruction execution.

Software and Programming

Software and programming for this computer go hand in hand since you are the builder. The software controls the computer s overall operation. The program controls the computer in a specific problem solving task. The differences between software and program are a little confusing, since the "whole works" of instruction words and all are called the computer's software.

By now you should have a pretty good idea of how to program your computer. If you haven't, refer to the section on the control circuits again and you will. To program the computer, you must know the task you need to perform, then you must generate the instructions that will accomplish this task.

Symbols have been designed to aid you in programming. These symbols are arranged to form a flow chart, or step-by-step picture of the computer's operation. Different flow chart symbols represent different functions just as different schematic symbols represent different components. Some basic flow chart symbols are shown in Fig. 12.

Figure 13 shows the flow chart symbols arranged to form a program. The chart shown is only part of a program, or routine that is used to control equipment from a TTY. This portion of the complete routine is

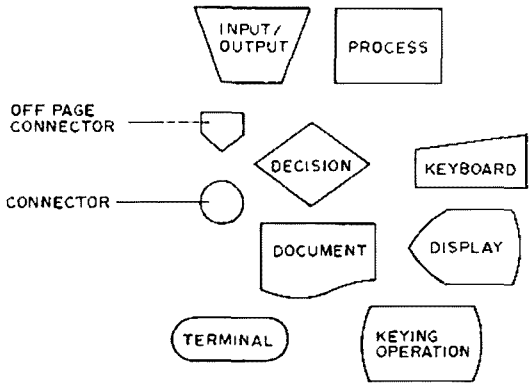


Fig. 12. Flowcharting symbols. The programmer uses these symbols to draw a schematic diagram of the tasks to be done to accomplish an end task. This "schematic" is then used as his reference to complete the programming.

called a subroutine because it performs a complete function within itself. The subroutine shown scans the input circuits again and again to see if a data word has been entered from the TTY. The figure is completely self-explanatory.

Software Meets Hardware

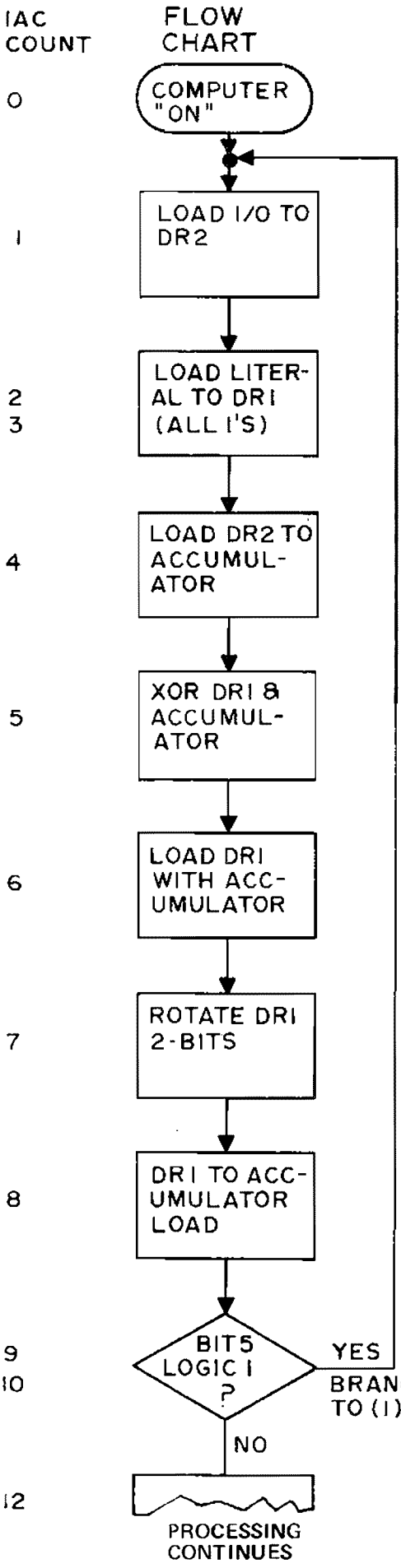
Figure 14 is a block diagram of the completed computer. You will use this block diagram when you program the computer to keep track of the data floating around in the machine. The machine in Fig. 14 uses an rom, but keep in mind that you may use core. If you use core, it will connect in place of the rom.

Notice how the accumulator register is shown. The accumulator has 8-outputs that parallel feed the instruction address counter. This is to enable the "branch to" address to load from the accumulator during the third operation cycle. Also note the inputs that feed the accumulator and accessible memory input selectors. Don't forget to send commands from the control circuits to the appropriate selectors.

To find out how the machine works as a complete unit, just refer to Fig. 13 and follow along in Fig. 14. The explanation in Fig. 13 should suffice as an explanation of the computer's operation.

Construction Problems

Wish there would be no construction problems. But for any project of this size, you will have some developmental problems.



1	10101110	This command causes data to read in from the I/O circuits. Note that there may be no data if none was entered.
2	01101001	This command will put the next instruction (a literal) in DR 1.
3	11111111	The literal.
4	10010111	We are moving data in to the accum and sending it right back into DR 2 to have it in both places.
5	01101101	This command will Exclusive Or the DR 1 and Accumulator signals, thus providing an inverted data output.
6	01101000	The inverted data from the arith section is in accumulator and we want to move it to DR 1.
7	01010000	Now the data in DR 1 is moved ahead two bits. Was: 7 6 5 4 3 2 1 0 STOP BAUD X X X X X START BAUD Is: 7 6 5 4 3 2 1 0 START BAUD STOP BAUD X X X X X
8	01100111	Inverted, rotated data is loaded into the accum in preparation for next step in program.
9	11000100	Data is checked for a "T" at bit 5. This means that there was no stop baud.
10	00000001	If no stop baud, the literal loads into the IAC and the program jumps to the beginning and the process starts again.
12	YOUR PROGRAM CONTINUES	If there was a stop baud your program will determine what it is.

Fig. 13. Detailed program. This is the first part of a routine designed to control some equipment on command of the TTY. This particular "subroutine" merely looks for the presence of any data input.

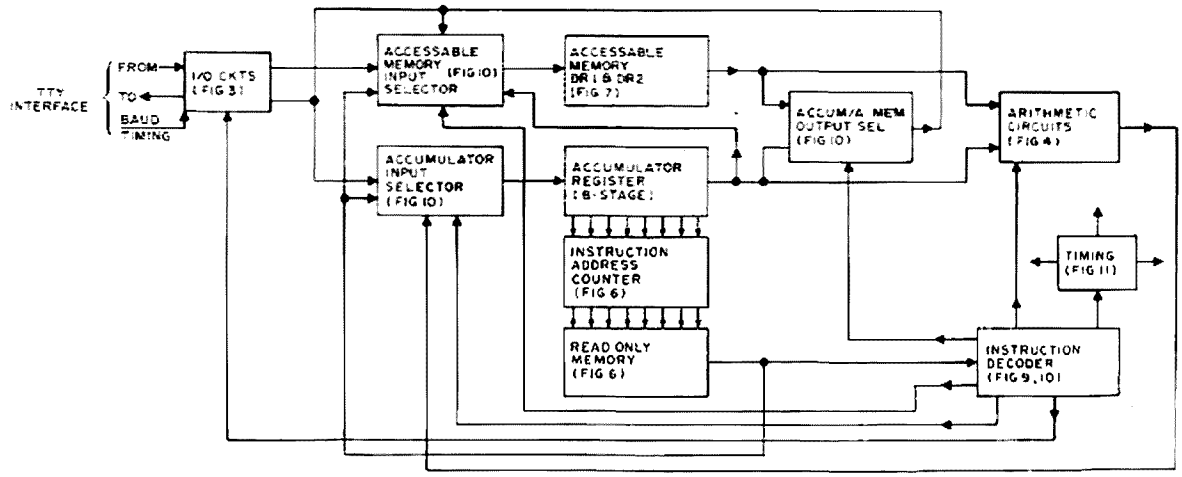


Fig. 14. Minicomputer block diagram. Mix up all ingredients in the manner shown and you have a complete minicomputer! All the action begins when the timing circuits start the count in the instruction address counter. Instruction number 1 tells the computer what to do next via the control circuits. The instruction will be whatever you program into the computer.

Even if you follow a tried and tested design verbatim. Power supply may end up being the most serious problem for you. Use a rule of thumb – overrate. Use a supply twice as large as necessary. And be sure to use power buses. Don't forget to use a common power ground also. This will eliminate many tears and much swearing!

You may wish to breadboard each of the circuits before you print a circuit. It has been my experience that the breadboard and the final version never work the same. I recommend that you design carefully, recheck, check again after a couple of days, then print the circuit. Build the final version first!

Interface Problems

Certainly, you won't be able to interface any or all peripherals with ease. Just choose one type of peripheral and then design for it. You will have to bring in peripheral bit timing to the computer (band rate timing in a TTY). You will have to figure out how to interface the peripheral you choose. A description of peripherals and how to interface them would be enough for a complete article by itself.

Now What?

You've got the computer, or you've got the knowledge that you wanted about how computers function. Now what can you do with this knowledge, or the machine?

First of all, with the knowledge, you can read a few good books and articles and understand enough of what they are saying to learn more. Since you know what basic machine language programming is like, you may want to go on and learn a higher level language or compiler. Finally, you can keep your eyes open for a good used computer and this article will provide excellent reference to aid you in programming and troubleshooting. (Incidentally, a friend of mine picked up a fine used computer for $3000! Don't scoff; he used it in his own little bookkeeping service business and has paid for it, and bought another.) There is a used computer dealer called "The Computer Exchange" which could supply you with price data on a used machine. The Computer Exchange Inc., 30 East 42nd Street, New York, NY 10017, phone 212-661-5870.

If you build your own machine, you can do anything your imagination will allow (the control circuits will have something to say about this too.) There is, of course, a point to what a computer can do. It can't replace your wife, because it couldn't change a baby's diaper. (Never overlook the possibility that you might fabricate a computerized robot that could darn socks or something.) The computer is not an "all solver" for the world's and your problems, but it might make a good sized dent if you're willing to try!

J. E. Kasser G3ZCZ/W8
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THE MINIMOD

The Minimod is a hybrid modulator for a low-power VHF transmitter of the type using a 3630 in the final. Since there is a B+ line present in the transmitter, the back end of the modulator has tubes, while the front end is transistorized to save on power consumption and cut down on heat dissipation.

The 2m rig used consists of a two-tube exciter and a 6360 running 12W input, modulated by the minimod. The whole rig is built into a box 8¾x5x5 in.

Circuit Description

The mike is coupled to the first transistor through a blocking circuit. The capacitor across the input socket shorts out any rf that tries to get into the modulator through the input socket. The coupling capacitor blocks the dc, and the series resistor acts as a choke to any rf that may get past the decoupling capacitor and as an impedance in series with the transistor.

The first two transistors form a dc feedback pair. These have very high gains, so that the first one (an emitter follower) presents a high input impedance. The high impedances in the input match the crystal mike used to generate the audio. The second transistor is a common-emitter amplifier directly coupled to the first transistor. Bias for the first transistor is obtained from its collector through a high value resistor.

The audio is capacitively coupled to the gain control and on to the second dc feedback pair. This second dc feedback pair consists of a common-emitter amplifier with negative feedback followed by a phase splitter. From the phase splitter the audio is passed to the grids of a conventional push-pull tube output stage.

Supply voltages are obtained from the main B+ line, with resistors used to drop the B+ to a suitable value for the transistors.

The second dc feedback pair has a supply voltage of about 50V so these

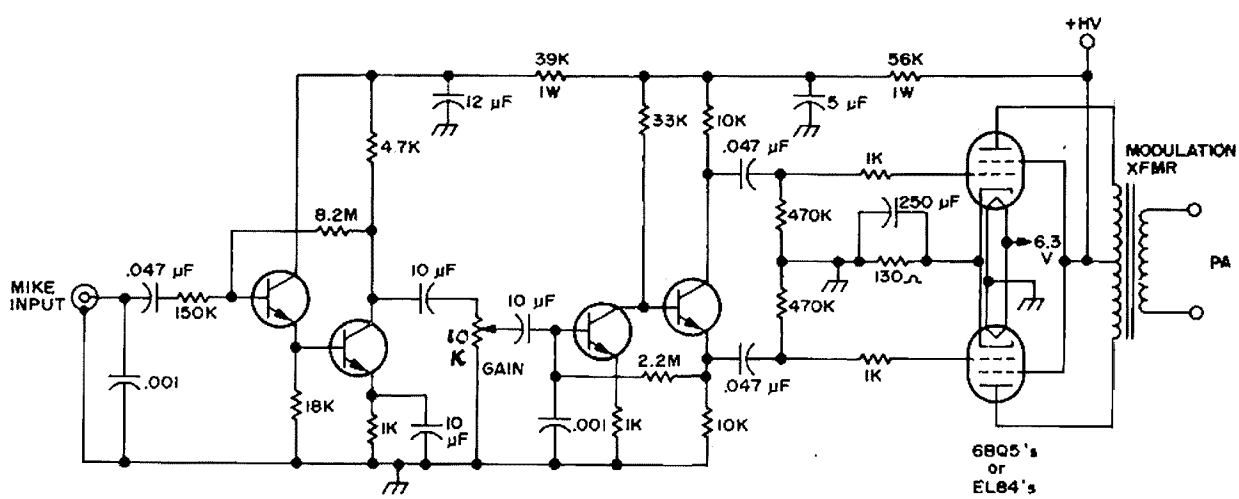


Fig. 1. Minimod schematic.

transistors must have a high collector breakdown voltage.

Construction

The main chassis has to be drilled to mount the tube bases and modulation transformer or a subchassis can be mounted in a suitable place. The transistor circuitry is built on a piece of laminate board. Its construction is not critical as long as care is taken to avoid picking up rf. The leads to the input socket and gain control are made up of shielded cable grounded at one end.

The capacitor at the input to the second dc feedback pair is to decouple any rf picked up on the leads to the gain control.

In the prototypes, the B+ was 280V, the phase splitter had a supply of 50V, and the front end 10V. Although the dc feedback pair is very tolerant with respect to supply voltage variations, should the B+ be much higher than 300V, the value of the first dropping resistor will have to be changed. The new value can be calculated using Ohm's Law.

The transistors used in the first dc feedback pair are a pair of 2N2926Gs. The second dc feedback pair uses transistors designed as Nixie drivers. Any type will do provided that their collector breakdown voltage is of the order of at least 80V.

By using dc feedback pairs, the circuit compensates itself for any change of transistor parameters, allowing type substitutions to be made.

The modulation transformer has to match into the final. The match is fairly critical; therefore, for best results choose a transformer that matches the final, although any old transformer will give *some* results.

Results

I have had constant reports of good modulation depth, and good sound, while using the minimod in my subminiature 2m rig. No particular shielding has been built around it and it does not seem to suffer from rf breakthrough.

I would like to thank G8BEH for his help in developing the minimod, and for his patience in the testing.

. . .G3ZCZ/W8

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UPDATE YOUR HEATH HR-10

Murray Ronald VE4RE
Box 974
Brandon, Manitoba
Canada

Among new amateurs the Heathkit HR-10 receiver is a very popular receiver. However although it does a good job on AM signals, its performance on CW and SSB leaves some margin for improvement. One of the problems is the lack of avc action when copying CW or SSB signals. Also the lack of regulated voltage on the local oscillator-mixer and bfo tubes results in some instability on the high bands. The modifications which follow correct these problems to such a degree that it will not seem like the same receiver. The addition of the audio-derived avc brings about the most startling improvement. With the rf gain fully on, copy is excellent on CW and very good on SSB except on very strong signals – all this with the existing detection system, too!

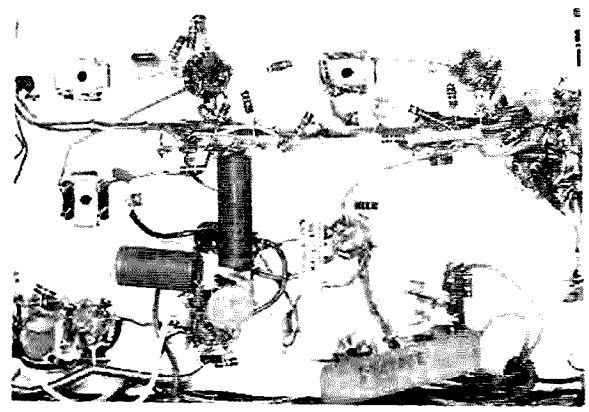
The modifications are not difficult or costly to make. With a little diligence the parts can be purchased for $10 or less. The changes can be easily incorporated when the kit is assembled. In fact, a new kit with these modifications represents real performance for your money.

Power Supply Modifications

Modifications to the power supply consist of installing silicon diodes in place of the 6X4 rectifier and adding an OA2 regulator tube. Removal of the 6X4 leaves a tube socket for the OA2 and allows addition of the 12AT7 avc amplifier without undue load on the filament transformer. A few directions follow:

1. Remove V7 and unsolder the red transformer leads from pins 1 and 6. The connections to pins 3 and 4 are left in place. Remove the lead to pin 7.

2. Install a terminal strip for the diodes



and 82Ω surge resistors. Complete the OA2 wiring.

3. Clip the two red leads carrying B+ to the junction of R13 and R41 at the single-lug terminal strip near V2. Solder the two red wires together and tape. Route a lead for the regulated voltage along the rear of the chassis and solder to the vacated lug on the terminal strip referred to above.

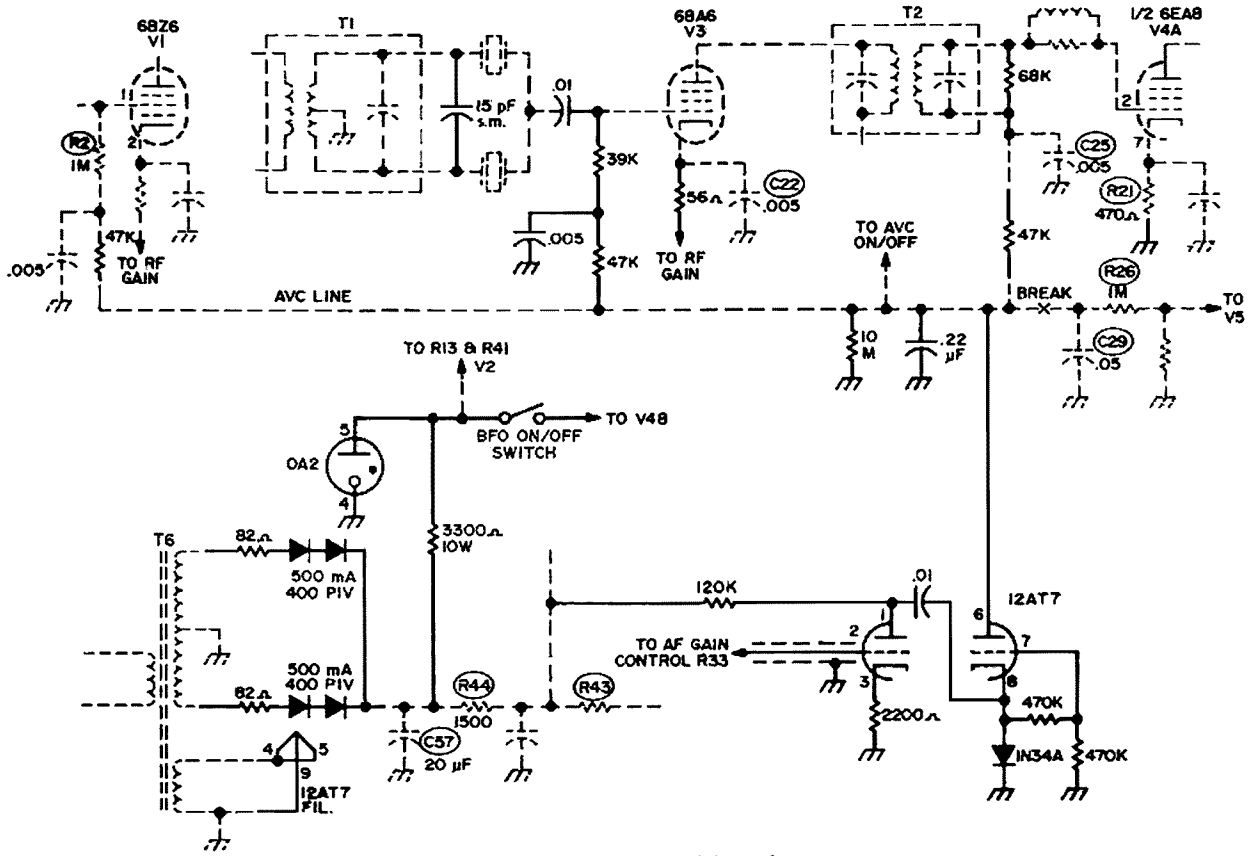
4. Run regulated voltage to the bfo switch to supply V4B All other stages remain unregulated.

Checks: B+ voltages will read 15 to 20V higher than before modification. A VOM inserted in series with the 3300Ω dropping resistor should read approximately 20 mA for proper regulation.

Audio avc Installation

The existing avc system is discarded except for the avc bus wiring and the avc on-off switch. Notice that the 6BA6 i-f amplifier is modified so that avc can be applied to a third stage. Almost any small-signal diode can be substituted for the 1N34A and either a 12AT7 or 12AU7 will work as an amplifier. Follow the hints below.

1. Remove the fuse block T and install



Schematic showing all wiring changes.

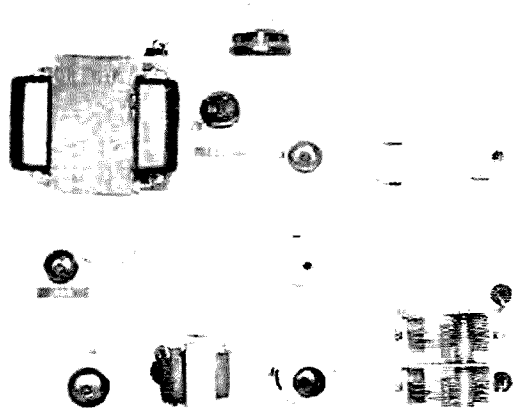
it vertically on the rear chassis apron between the speaker jack and line cord.

2. Install a 9-pin socket between the power transformer and V3. Refer to accompanying photo.

3. Run a shielded lead from the 12AT7 grid to the af gain control. The shield connects to lug 1, the center conductor to lug 3.

4. Ground R21 at V4A. This prevents pinning of the S meter when the rf gain is turned down. Modify the 6BA6 i-f stage. Install 47K resistors in place of R3 and R19.

Checks: With the rf gain fully on, the negative avc voltage should read approximately 1V with no signal and 6–7V on very strong signals. Voltage measurements on the avc line must be made with a VTVM.



I-f Bandpass Changes

Changes to the secondaries of T1 and T2 will alter the i-f bandpass to give a sharper response. T1 and T2 should be retuned slightly after making these modifications. With antenna disconnected and the gains turned up, adjust the slugs for maximum noise while keeping the "hiss" at its lowest pitch. Alternatively, peak T2 as above and then adjust T1 while listening to a weaker SSB signal. Tune for maximum strength and best sounding signal.

I have made these modifications to several HR-10 receivers, and in all cases the owners were well satisfied with the results. Readers might refer to some earlier articles for background information.[1] [2]

...VE4RE

References

[1] *M. B. Crowley, EI4R, "Controlled Audio AVC System," 73 Magazine, April 1966, p. 84.*

[2] *W. Montague, VE3FYL, "Heath HR-10 Modifications," 73 Magazine, July 1967, p. 86.*

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10M SOLID STATE

The basic design for this 28 MHz, one watt, solid state transmitter, was developed on 50 MHz. By the time I had it working, the band had gone dead. So I shifted it to 28 MHz. With a few minor changes, it will work on either band, using the same transistors and suitable inductances.

There are three unconventional features about the design, one being the neutralized buffer stage, because on 50 MHz I found it necessary to neutralize *both* buffer and final. The neutralization is not to prevent self-oscillation as one might think. What it does do is to greatly improve the modulation characteristics. On 50 MHz it also cleaned up some TVI that appeared during modulation peaks.

Another unusual feature is the final tank circuit. It is really a pair of tank circuits in parallel. The exact configuration was arrived at by trial and error. However, since any change that I make in it seems to cause the output to drop, the logical thing is to leave it the way it is.

I normally run the transmitter from the cigar lighter in my Volvo. The car battery voltage is 12.4V with a negative ground. At this voltage the final draws .060A for a dc input of 750 mW. The input can be raised to 1W by inserting an extra 1.5V dry cell in series with the 12.4V to the modulation transformer secondary. There is so little difference at the receiving end that I seldom bother to do it.

The audio section is a 12V, 1W commercial amplifier obtained from Radio Shack for $5.95. At that price, it's hardly worth while to build your own. The only trouble with this one – and most low-priced audio amplifiers – is that it has a positive ground. Be careful what you do with the microphone shield ground and the volume control ground. Naturally you will insulate the amplifier printed circuit board from the metal box in which it resides. Don't do what I did, and hard wire the volume control to both the amplifier ground and the aluminum box at the same time. All it did was to wipe out a half-inch section of printed circuit trace leading to the power switch. Fortunately this was easily replaced.

There is always a problem in locating a suitable modulation transformer for the higher powered solid state transmitters. That is the reason for the 1W output transformer wired back to back with the output transformer of the regular amplifier. This system is not 100% efficient, but it does get around the problem. Since we have more audio than we really need, the loss of efficiency is not serious.

The most unique feature is the combination of the diode and audio bypass condenser in series with the buffer collector. This arrangement was evolved in the process of obtaining upward modulation of the output. The result was semi-spectacular. Since there is no splatter and no appreciable distortion at the receiving end, it appears to be a practical approach. The 1K resistor (in the dc path) was chosen in order to provide the

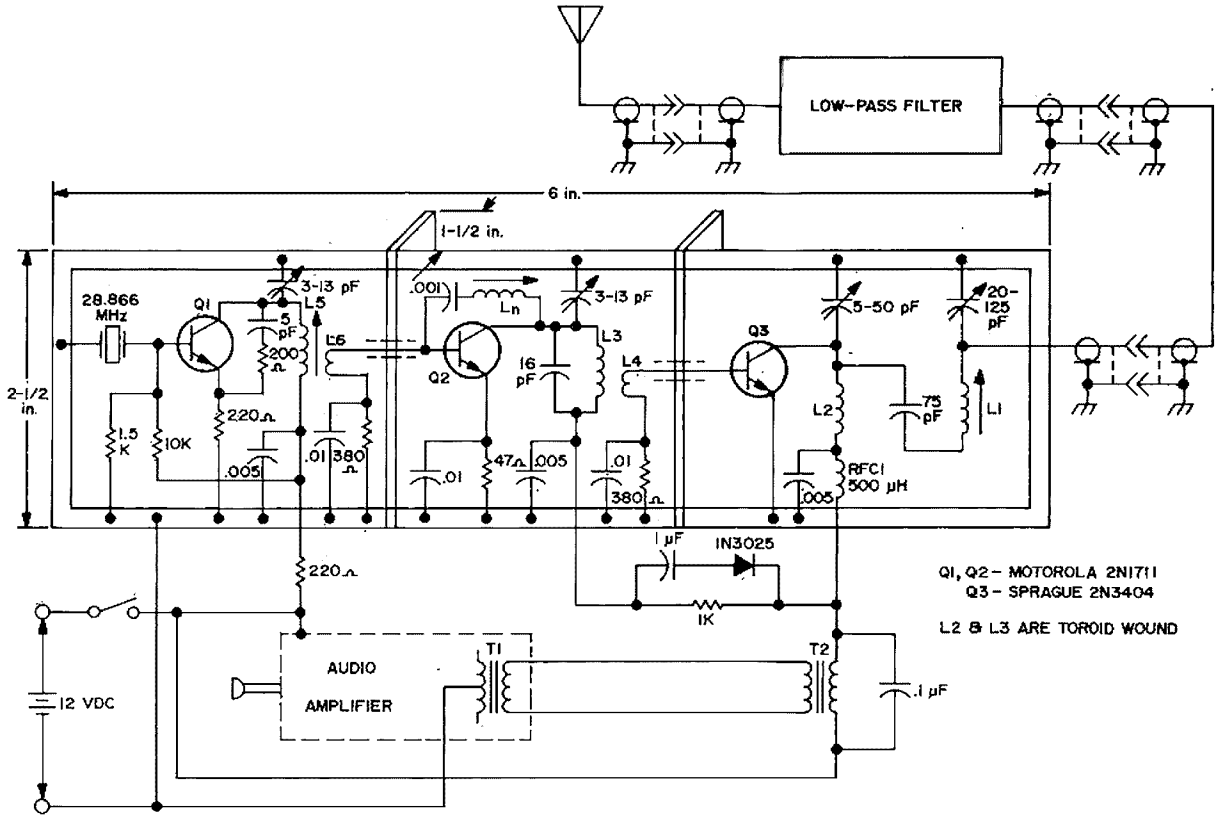


Fig. 1. Schematic of the 28 to 50 MHz rig. Coil data: L1, 3/8 in. dia. 6T #18 ½ in. length; L2, "Red" core toroid, 7T; L3, "Red" core toroid, 8T; L4, 2T wound over L3; (Note: Buy one Amitron package — use the "Red" core for L2 and the "Yellow" core for L3. Use 10T for L3 and 3T for L4. 28 to 30 MHz happens to be the area in the spectrum where the "red" and "yellow" cores overlap.) L5, ¼ in. dia. 10T, #22, ½ in. length; L6, 2T over cold end of L5; L7, ½ in. dia. 24T #24, close spaced (or J. W. Miller #4204 5–12 μH choke); T2, 1W transistor output transformer 150Ω : 8Ω, dc resistance 8Ω pri. : 1Ω sec.

proper amount of drive for the final.

The 2N1711 is a surprise, especially up on 50 MHz. It turns out that only certain brands of 1711's work at the higher frequencies. The Fairchild 2N1711 does not work. Apparently it is manufactured by a different process than the Motorola 2N1711's which I am using. A friend who works at Fairchild refsued to believe this. He took my MOT 2N1711's into the Fairchild lab and verified there was indeed a difference.

If you cannot find MOT 2N1711's, then I recommend the little brother of Sprague 2N3404, which is the 2N3414. It can be used as oscillator and buffer. The RCA 2N3118 will work in the final, but it costs four times as much as the Sprague, and does not work any better.

The low-pass filter is pretty much a requirement. My 5W CB transceiver has one built in. Solid state finals are always rich in harmonic output. Be certain to measure the output power on the downstream side of the filter. Otherwise you won't know whether any improvements you make are increasing the output at the fundamental or merely increasing the harmonic output.

The neutralizing coil for the buffer is rather large at 29 MHz. What is needed is a combination of "C" in picofarads and "L" in microhenries that will equal 30 (for 29 MHz) when multiplied together. My approach is to take a 2 pF fixed capacitor and solder it across the coil. Then adjust the turns on the coil to get a dip at 29 MHz with the slug all the way inserted. That indicates a 15 μH coil (ignoring the distributed capacity of the winding). Of course if you prefer the chicken method, just take a National XR coil form and wind on 24 turns of #24 wire close spaced.

Some type of rf power and VSWR indicator is highly desirable for checking the output and also the modulation. There are two types of these gadgets sold for use in CB rigs for under $10. Either one works fine on

28 or 50 MHz. My rig with 12.4V input will provide 2.2V defection on the 3V scale. If I wanted full scale deflection for VSWR measuring purposes I would simply add a 6V battery in series with the 12.4V car battery (but don't modulate it under these conditions).

It turns out that an NE-49 pilot light soldered across the end of a piece of RG-58 coax makes a fine dummy load and modulation indicator. The VSWR checks out about 1.1 to 1.0. I can light the bulb to full brilliance by blowing in the microphone with only 12.4V dc input.

I am using the Hustler mobile loaded whip antenna mounted on the rear bumper of the Volvo. The VSWR checks 1.3 to 1, which is satisfactory. Solid state final amplifiers do not tolerate high VSWRs. Anything worse than 1.5 to 1 may cause trouble.

Just as I was about to mail this article to 73 I made an important discovery. It came about when I moved the modulation transformer T2 from its original position on top of the chassis to a neater looking spot near the crystal oscillator. Everything fell apart. The output fell way off and the modulator ceased to modulate.

Because I am a ham first and an engineer only from necessity, I stumbled over the answer. The bypass condenser across the secondary of the modulation transformer cured the problem. I first tried a .002 mF bypass which did not seem to help at all. Next I tried the .1 mF capacitor that appears in the schematic and everything worked again. You may not need it. It apparently depends on the placement of parts. On the other hand, it doesn't seem to hurt. In fact, it seemed to help a little over the original configuration.

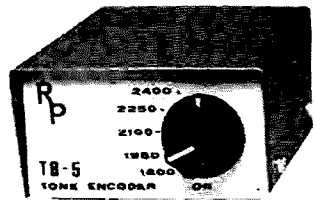
On the air the expanded positive peak modulation can be mistaken for double sideband with slightly more carrier than normal. The only disadvantage is that some distortion products are perhaps generated which appear on Channel 5 if in close proximity to the TV receiver. The Drake 100W lo-pass filter will take care of this problem if it is bothersome. Naturally, we don't really need a 100W filter, but Drake doesn't build a smaller one.

. . .W6OSA

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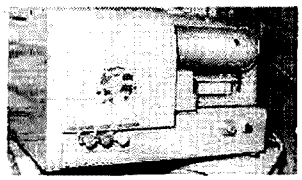
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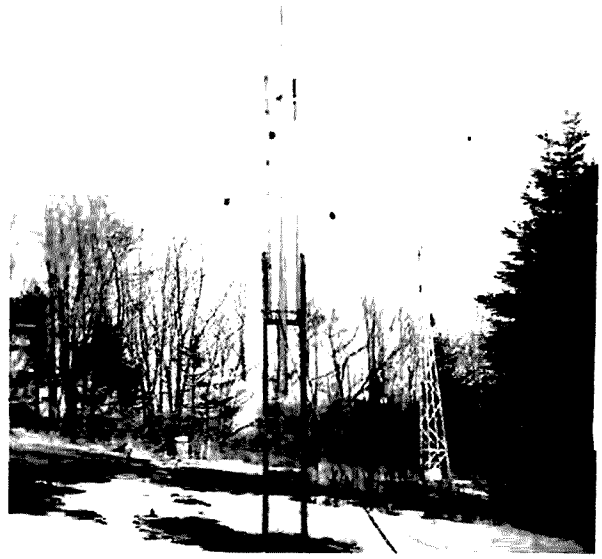
The recent serious rise in postal rates will be forcing 73 to increase the subscription rate soon – don't say you weren't warned.

Did you enjoy the article in August on the DXpedition to Navassa? This is one of the reasons that 73 is different – it is involved. The editors get out there and operate, go on DXpeditions, organize them even – organize ham tours – set up repeaters – work in the contests – work lots of DX – are actually on slow scan – on RTTY – it makes the magazine come alive. When the editors write about something you know that they have the background to bring you the inside scoop. If you are the type of person who fights progress – opposes change, you are going to find 73 getting your back up, for 73 is in there first with the new things.

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George Cousins VE1TG
R.R. 2, Box 18
Lower Sackville, N.S., Canada

A HUSKY 40 M GROUND PLANE



It seems that the middle of the winter is the time I end up building antennas, which may be because of the coincidence of the contest season. However, this was quite a mild winter in these parts, so come February the need for a 40m antenna found another project being conducted between the sporadic snowflakes.

Since I had experience with 40m groundplanes in high-wind areas, it was obvious that such an antenna must be built with an eye to strength as well as performance. It seems most groundplanes are thrown together out of TV tubing or similar material, and the end product seldom lasts long. On 40m the 33 ft of vertical radiator must be well supported.

A little study of Fig. 1 and the photographs will reveal most of the construction features of this antenna. The main support framework is made of well-seasoned 2x4s, with four sections being used to form the legs and a number of short pieces used for spacer blocks. Carriage bolts and lag screws are used in place of nails to prevent premature parting due to wind flexing.

Two short pieces of angle aluminum are also bolted across the frame legs; these are used as the main supports for the radiator. The radiator itself is very sturdy, being made of three sections of aluminum tubing. The bottom section is a 20 ft length of 3 in. irrigation tubing, an item respected for use in yagi beam construction. Besides being very lightweight, this material is able to withstand years of wind and weather stresses.

Telescoped inside the bottom section is a length of 2 in. irrigation tubing. In my case this was a scrap piece from a quad project, but if you have a full 20 ft length available, this would be ideal to complete the overall length of the antenna. In my situation I was forced to go to a third section which is a 10 ft length of thick-wall aluminum conduit such as the type used for house wiring. The three pieces are telescoped inside each other to make up the required 33 ft of overall length, with sufficient overlap to insure strength at the two junction points.

Probably the hardest part of the whole project is to accurately position the pipes inside each other so that the three pieces are concentric, while allowing proper electrical connection between each other. The best way, if a machine shop is available, would be to machine aluminum spacers or collars that would fit inside the larger diameter tubing and have a hole in the center to accommodate the smaller size. However, some study of Fig. 2 will show a

suitable method which will serve the purpose.

Four small blocks of hardwood are used, cut from a single piece of square hardwood molding. The four blocks are wrapped in thick aluminum foil (the kind used to wrap electronic equipment for shipment). The foil usually has a backing of a canvas-like material, and the idea is to wrap the wood so that the foil will make contact with both the outer and inner pipe.

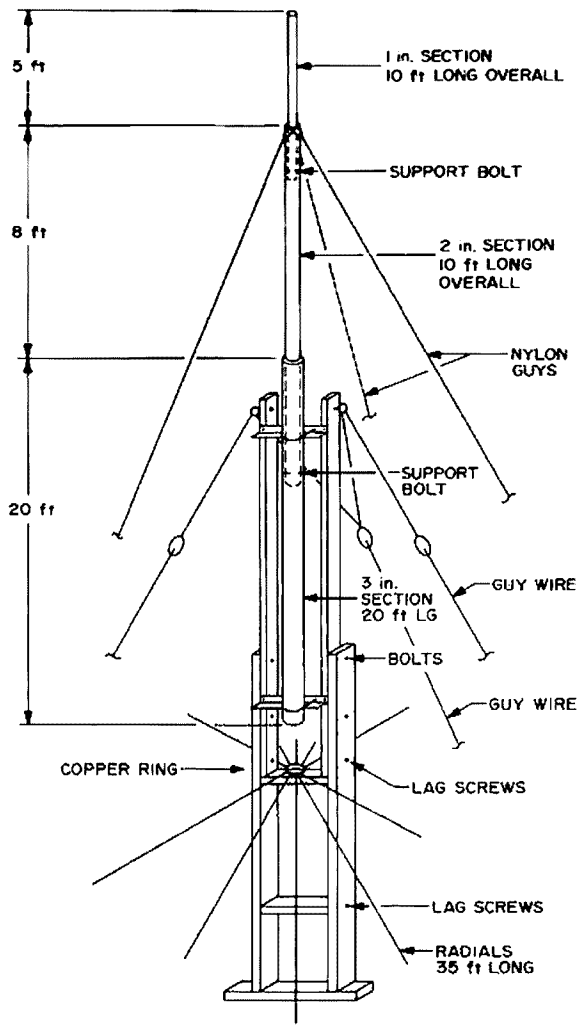


Fig. 1. Details of overall construction.

I held the foil on the wood with a generous dose of glue. Position the four blocks around the inner tubing and use dabs of epoxy to fasten them to the pipe. This is only really necessary on the lower blocks because they will be too far down inside the outer pipe to be reached. The blocks at the upper end of the pipe can be tapped into place at the top of the pipe.

As a means of supporting the pipe at the correct length, two small aluminum bolts are used to hold the inner pipe in position. These are deliberately placed at the lower end of the inner pipe to avoid any mechanical weakness at the junction.

We cannot really depend upon this for good electrical connection, although it will likely be quite sufficient. However, Fig. 3 shows the bridging connection at the junction of the pipes. This is made quite simply by using strips of grounding braid and stainless steel hose clamps.

Fastening the completed radiator in position is the next step. The simplest way is by using two large muffler clamps, well primed with several coats of rust inhibitor. These are ideal for gripping the large tubing firmly and yet not denting it. The clamps are placed around the tubing and mounted onto the two angle aluminum cross pieces on the frame.

At this point, decide upon the distance you want from the ground level to the bottom of the radiator, and then slide the radiator through the clamps until it is in the required position. The distance will depend somewhat on personal preference or availability of space for radials. If you intend to bury the radials, the base can be very close to the ground, but in my case I have the radials above ground and sloping downward at a 10-degree angle. This gives a little better match for RG-8/U cable, and also allows the radials to be rolled up easily when summer lawn mowing becomes necessary.

Before attaching radials, the antenna can be raised into position and guyed. By pegging the base to a short pipe or stake driven into the ground, the antenna can be raised by one man. However, have a helper on hand to tie down the guy wires or disaster may overtake you! Two sets of guys are used. The lower guys are attached to the main frame, and can be your choice of materials. I used heavy aluminum clothesline wire covered with heavy plastic – it's easy to work with and not prone to kinking. A strain insulator in each guy breaks up any possible resonance in the wire.

Mark the positions for the three lower guys, in an equal triangle and about 10 ft out from the base. The stakes should be at

least 4 ft long and driven into the earth to almost their full length. As a suggestion, drill the ends of the stakes and insert a steel U-bolt, which will offer much easier attaching of the guy wires. A steel turnbuckle between this U-bolt and the guy wire will offer precise adjustment of tension on each guy and save a lot of bothersome hit-and-miss tightening later. I have also extended the guy wires from the turnbuckle back to the base of the frame. This prevents any tendency of the base to move sideways under high winds.

The upper set of guys are made from an insulating line (nylon, polypropylene, etc.), but try to use a line with minimum stretch and also one which is impervious to rapid changes in temperature or wetness. Be especially certain it will not rot. If available in your area, it's hard to beat the woven line used for deep-sea fishing nets. This is virtually indestructible and good for years of use.

Fasten the upper set of guys directly to the radiator at the top of the 3 in. pipe. These guys may be fastened to the same stakes as the lower set, but a much stronger arrangement can be had by using another set of stakes some 5–10 ft farther out from the base.

When the antenna is raised and guyed, the radial system can be installed. How many? Simple. The most you can get. More radials mean more efficiency and lower angle of radiation. Of course it's very hard to measure the slight improvement that one more radial makes, but 10 more radials

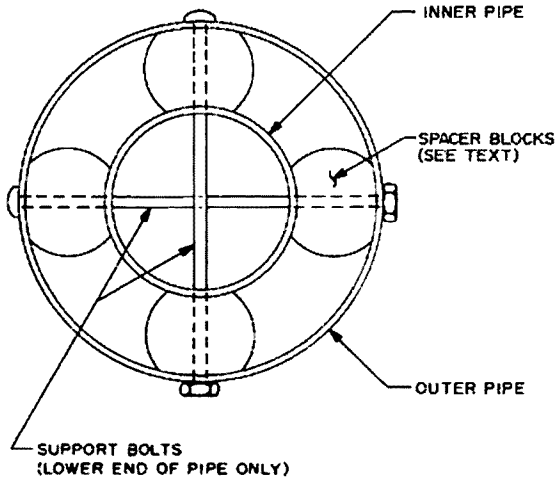


Fig. 2. Details of pipe junctions for tight fit.

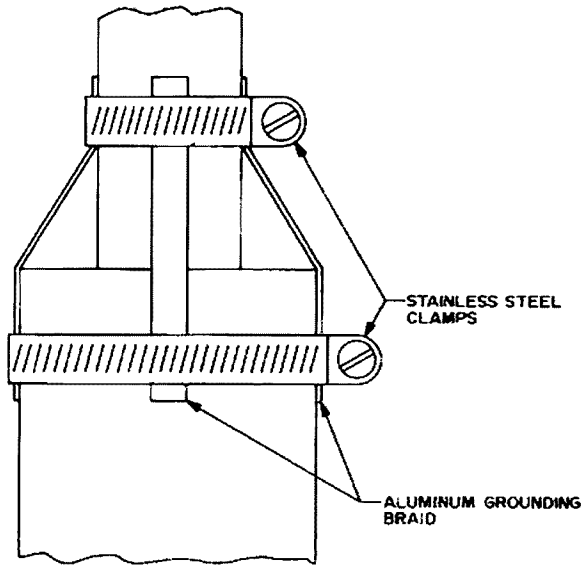


Fig. 3. Method of electrically bridging the junction of the radiator sections.

may get your attention. They can be made from any wire you can get.

The length of the radials should be about 10% longer than the radiator. The ends of the antenna can be all cleaned, soldered together, and then clamped or soldered to a short piece of copper braid which in turn is soldered to the shield of the coax feedline, either directly or via a connector. Although the ideal pattern for the radials would be to space them equally in a circle around the radiator, they can be bent or crammed into whatever odd space is available without seriously lowering the efficiency of the antenna.

Standard 50Ω cable is used to feed the radiator, and direct feed to the base of the element will result in a reasonable swr in the neighborhood of 1:1.5 or a little lower. However, a closer match (and an swr nearer unity) can be achieved by use of a coaxial matching section.

The antenna will perform very well. I believe my best DX (in rarity, not miles) is FB8XX, but the log contains many QSOs with VK, ZL, 9J2, 5H3, 5Z4 and most European countries. The wind loading is slight, and with reasonable attention to painting the frame occasionally and checking the guys, the antenna should give excellent satisfaction for many years.

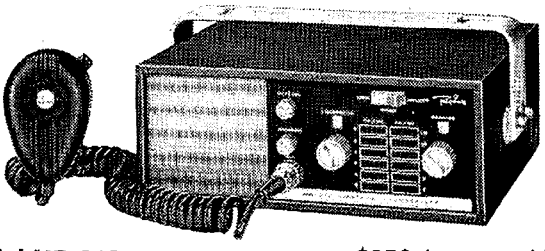
. . .VE1TG

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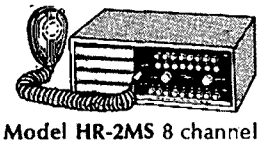
Specifications

Power Output: 20 watts (nom.) at 13.8 V DC
Frequency Range: 144-148 MHz
Channels: 12; crystal controlled
Sensitivity: 0.4 uv, 20 DB quieting
Spurious Rejection: 60 DB

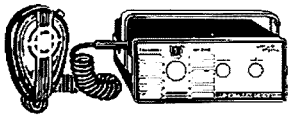


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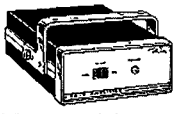
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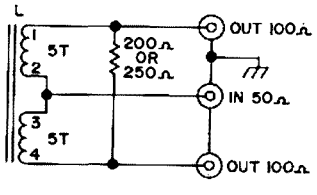
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Regency 2 Meter FM—American made at import prices

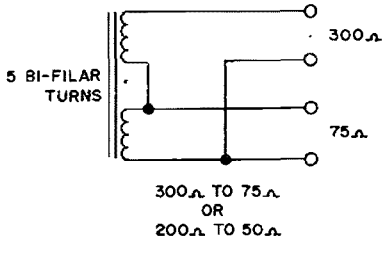
Henry H. Cross W1OOP
111 Birds Hill Ave.
Needham MA 02192

ONE CONVERTER INTO TWO RECEIVERS (such as for VHF contests)

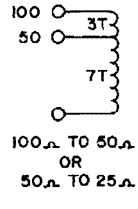
If we assume that your converter output is 50Ω and that the average ten- or twenty-meter receiver you use for a tunable i-f is something like 100Ω input impedance, it would seem that you could parallel two receivers with no trouble. However, you will find trouble with (1) leakage and (2) "sucking out" of the signals by the antenna-tuned circuit of the other receiver.



Padding with resistor networks helps, but the right way is with a "power divider." L is a centertapped coil. I twisted a pair of #30 Formvar wires together and wound five bifilar turns through a ferrite bead of the kind we used to use for heater decoupling – 3/16 in. diameter by 3/16 in.



long x 1/16 in. hole. Pick the proper ends to hook together, and we have 10 turn, centertapped coil. The two outputs are 100Ω each. Ten turns tapped at seven on

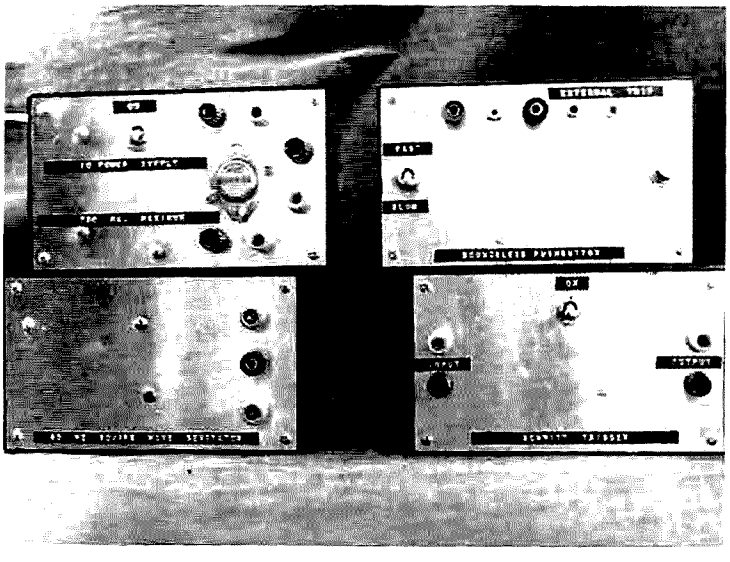


one of the same beads will make you a 100:50Ω auto transformer, if you think it will help.

...W1OOP

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IC LOGIC DOESN'T HAVE TO BE OBSCURE



With 40 meters a mass of heterodynes and 15 meters sporadic my two Novices had some time on their hands. Putting aside a study of the latest schematic diagram in the Playboy centerfold, I unveiled my latest bargain buy, a gaggle of J-K flip-flops and dual two-input gates. With an introduction to the world of IC's via the verbal route, it soon became apparent that some sort of dynamic demonstrator was needed. Several days of drawing schematics, hacking up perf board and constant construction produced a number of units which brought reality to the fundamentals of "counting with educated stones."

The first unit was a power supply. Since all the IC's were RTL, the supply voltage ballpark figure was 4V no-load running down to 3.6V when loaded to about 700 mils. Just a word about the power transistor in the regulated supply – while I used an available unit on hand, there is nothing magic about the number. Almost any decent

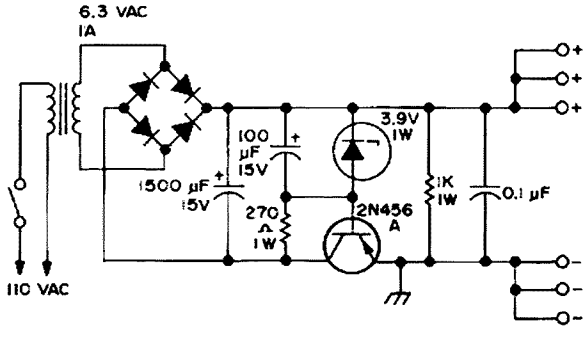


Fig. 1. Power supply for IC demonstration projects.

power transistor will work. By changing the base resistor a bit, up or down, depending on the zener you have on hand, the power supply should present no problem. I used

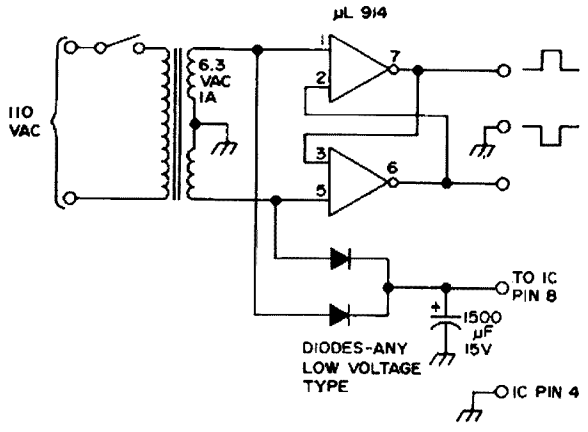


Fig. 2. 60 Hz square waver.

standard 5-way binding posts on all units.

The second unit constructed was the 60 Hz square waver. This essentially is an R-S flip-flop using a dual two-input gate, which is triggered by the 60 Hz from the filament transformer.

This unit was handy as its known frequency square wave was used in demonstrations of methods of frequency counting via oscilloscope patterns when the logic counting board was to be used.

The third unit was a Schmitt trigger

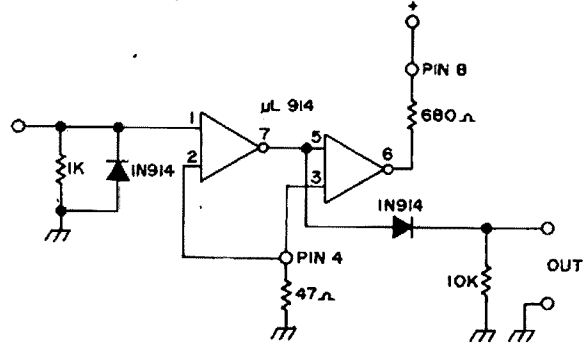


Fig. 3. Schmitt trigger.

which will produce relatively decent square waves from any audio source of 3V or more. It uses another dual two-input gate. Two C cells power this unit. As the current drain is well in excess of what would allow normal shelf-life of the cells, an on-off switch is part of this unit.

The fourth unit was a bounceless pushbutton. This is a device using another dual two-input gate which gives you one – and only one – output pulse when a pushbutton is pushed. I have incorporated two different pulse lengths selected by a toggle switch. The long duration pulse (about one second)

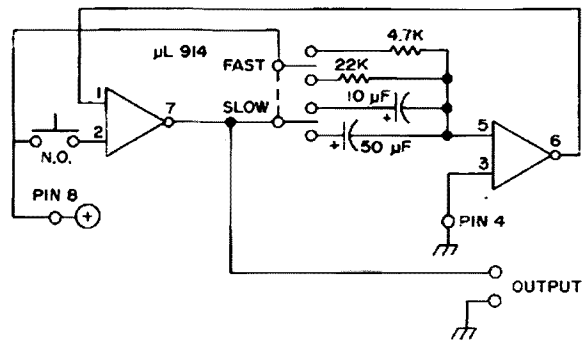


Fig. 4. Bounceless pushbutton.

is very useful as it allows you to put a meter from the output terminal to ground and see very graphically how when the button is pushed, the output voltage drops to ground, stays there for the designated interval and then snaps back to its initital value. The current drain of this unit is very low so no battery switch was incorporated and the two C cells will give long service. All four units described so far were built into small plastic boxes with metal panels, readily available from such outlets as Lafayette or Radio Shack.

The final unit, the logic board, was built on a 10 by 10 in. piece of Masonite. The perf board carrying the semiconductors is mounted underneath this panel. Essentially the logic board consists of four RTL J-K flip-flops. Each output of each flip-flop has a lamp driving transistor to show the state of each output. The NPN lamp drivers can be any small transistor with a gain of fifty or more. The base resistor serves to limit the loading on the flip-flop and also control the current through the lamps so they are not overvolted. The No. 49 pilot lamps were friction-fitted into 3/8 in. holes in the Masonite panel and connection to them made by soldering directly to the base. Note

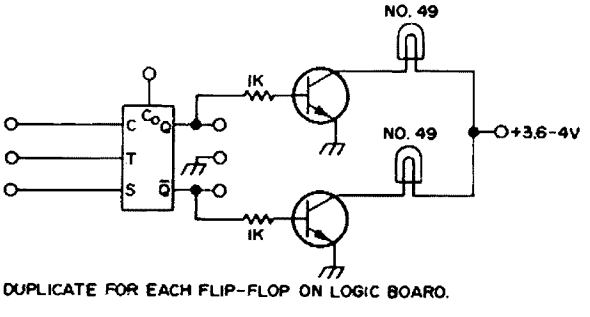
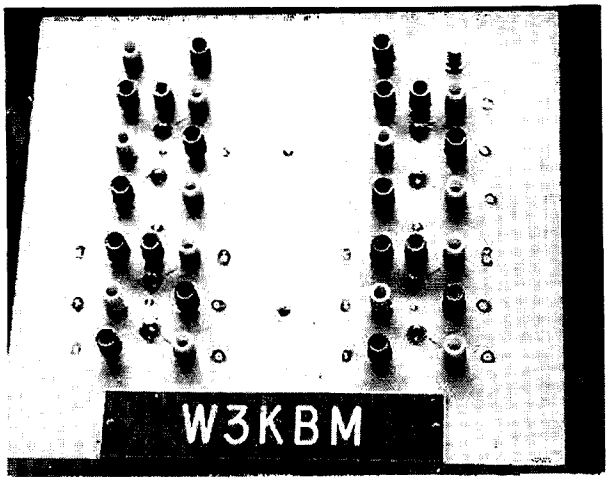


Fig. 5. Sample logic board flip-flop with pilot light display. Author's model included four of these.



Top view of logic board. Reset button at top right.

that each IC has a panel binding post for each input and output for a total of six per IC. In addition a ground binding post is included in each IC binding post cluster.

The only other item on the logic board is a "reset" button. This normally gives a ground when connected to the Preclear inputs. When pushed, however, it gives a momentary connection to Plus which serves to restore the flip-flop to its normal state.

A patch cord system like this is very flexible but demands many connecting cords. I made up multiple connecting cords for the ground system of each IC using spade lugs – three wires in multiple to one spade lug and the other end of each wire having its own spade lug. A similar harness was made up for the "reset" button but this included four wires so all flip-flops could be reset at once if the occasion demanded.

With the simple units described here you can demonstrate binary counting up to number 16 or by alternate connection of the flip-flops, divide by any other number. The bounceless pushbutton is particularly valuable in this use because as you step the counter pulse by pulse, you can make up truth tables based on what the lights show. Naturally if the input is derived from the 60 Hz square waver or the Schmitt trigger, the

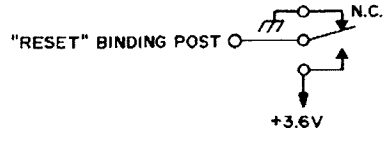


Fig. 6. Reset button detail.

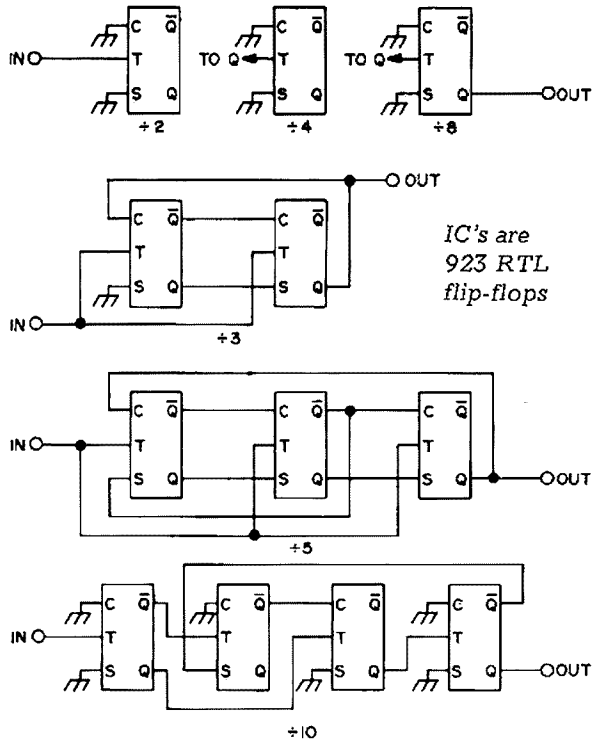
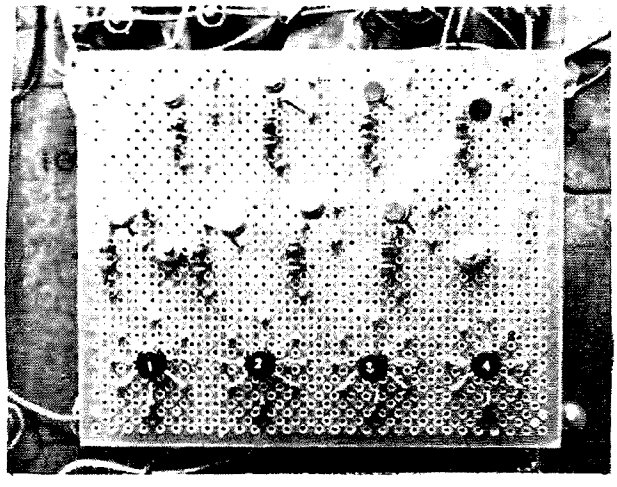


Fig. 7. Logic board sub-assembly

lights in each counting stage will flash at varying rates dependent on the division ratio involved. If the count is much above 140 Hz the bulbs will not blink but will give a steady light due to the persistence of vision and thermal capacity effects of the lamp filaments.



Underside of logic sub-assembly. Black TO-5 cases are RTL flip-flops. Others are lamp drivers.

This little logic demonstrator has really brought the world of IC's alive for my crew. The only tough part is getting the "toy" away from the younger harmonics so it can be used for "serious" teaching.

. . .W3KBM

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PROTECT THOSE DIODES

In designing the high voltage supply for high power equipment, many amateurs are turning to silicon diodes, and rightly so, because of their low internal voltage drop, filamentless operation, and reliability. Reliability, that is, if their maximum ratings are not exceeded. In order to rectify a high ac voltage, it is often necessary to use several diodes in series. However, a problem rears its three ugly heads in the form of Peak Inverse Voltage, creating headaches both in the cranium and billfold departments.

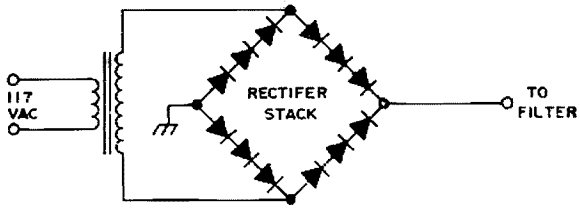


Fig. 1. Standard bridge rectifier using series silicon diodes.

Take Fig. 1, a typical bridge rectified unit. As the primary of the transformer is opened and closed, a high voltage transient appears across the secondary due to a change in core flux. The transient may exceed the PIV rating of the diodes, causing one or more to 'Go West,' and taking the rest of the string along because of a high distributed inverse voltage across them.

The second ugly head is the different characteristics of diodes of the same style. Their maximum PIV may be close, but not the same. These differences may cause the designed PIV to exceed the actual diode PIV rating. The result – abject failure.

The third ugly head arises in the multiple series diode rectifier legs. As the state of the diodes changes from non-conducting to conducting, an indefinite period of time (charge recovery time) occurs. If one diode in the string has a longer recovery time than the rest, it forces the other diodes to carry the extra PIV load until the diode recovers. This additional distributed voltage may be enough to cause one or more diodes to fail, again taking the entire string with it.

As in Fig. 2, the problems can be solved. The transient across the secondary can be eliminated by placing C1, a .005 mF disc, across the entire winding. The capacitor presents a low impedance to the transient, shunting it around the rectifier stack. The voltage rating of C1 should be greater than the peak secondary voltage. (A 5 kV unit will do for a 2000V secondary.) The extra distributed PIV is also easily eliminated. All that is necessary is to distribute the inverse voltage drop across *each* diode by shunting each diode with a .002 mF disc (1200V rating in this case). During the recovery time, capacitors C2–C13 present a low impedance shunt for the inverse voltage around the rectifiers. They also compensate for the different characteristics of the diodes.

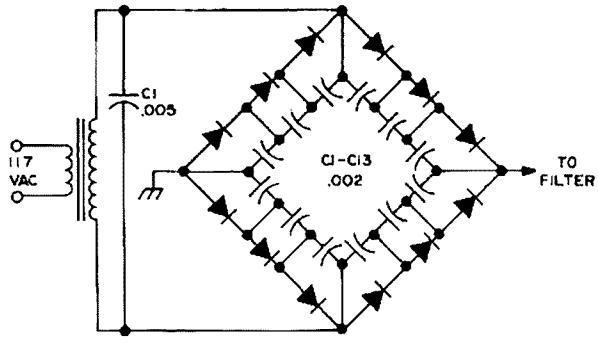


Fig. 2. Capacitor protection from transients across series diodes.

Try these hints and see if they relieve the headaches (especially those in the wallet) and improve the reliability of your operation.

. . .WA4CMQ

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SOLID-STATE OVERLOAD PROTECTION

There are two basic reasons for overload protection in your transmitter or linear. The first is a desire to protect the final tubes from the ravages of excess current. The second and equally important reason is to protect the power supply. While the transformer is often overlooked, it too requires care if it is to survive. In commercial and homebrew equipment careful calculations have been made to extract the last possible watt from a given transformer, the duty cycle has been figured to a fraction of a percent, and if ratings are exceeded there may well be dire consequences in the form of overheating and eventual failure.

Overload protection may be gained in any of several ways. The most common and least expensive over the short haul is a common fuse in the primary and/or secondary of the high voltage transformer. If a high current fuse is used, protection is sacrificed while a fuse near the normal current consumption of the equipment will give rise to frequent fuse changes due to the peaks found in all sideband equipment. Another common form of overload protection is a relay in series with the plate circuit. Excess current will pull the relay in, after which time a holding contact on the same relay will keep the contacts open until reset. The major drawbacks of this system are the lack of precise and lasting adjustment and the usual buzzing of the relay as pull-in current is approached. Presented here is another method which is silent, fully adjustable, reliable, and best of all, inexpensive.

A low value resistor (R1) has been inserted in the negative lead of the power supply. All current flowing from the supply must flow through this resistor and as it does it creates a voltage which is a reflection of the current flow. In parallel with this resistor is a potentiometer (R2) which allows the selection of any desired percentage of the voltage so developed. The slider of the pot is connected to a zener diode (D1) which blocks the flow of current until the applied voltage exceeds the zener point of the diode. The instant the zener voltage is exceeded, current flows through limiting resistor (R3) and the gate circuit of the SCR. The current flow locks the SCR into conduction, a condition which will remain until the anode/cathode circuit is broken or the supply voltage is removed. The overload relay coil is wired in parallel with the SCR. When the SCR conducts, the coil is effectively shorted and its contacts open. This in turn opens the coil circuit of the high voltage control relay and turns off the high voltage.

The high voltage on/off switch wiring is reduced to a single low voltage wire running from the power supply to a convenient location on the main chassis. The same line is also used for reset purposes, thus eliminating complicated switching and cabling. The reset function consists of turning off the high voltage switch momentarily. This removes the voltage from the SCR and allows the overload relay to operate when voltage is again applied. Both pull-in and reset are accomplished in a matter of microseconds. If the condition

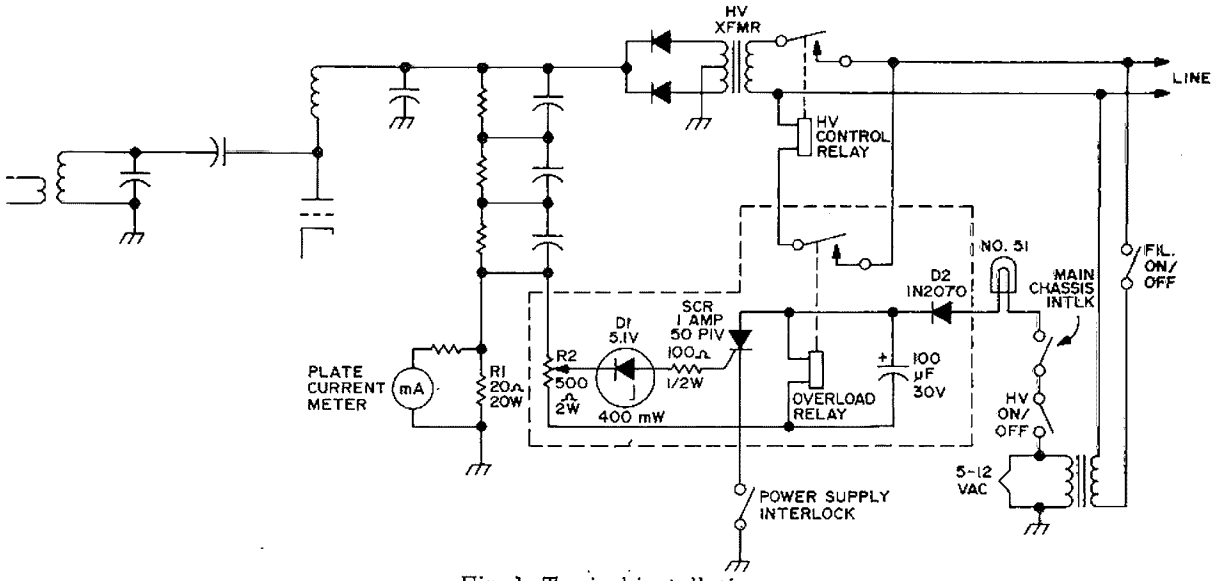


Fig. 1. Typical installation.

originally causing the high current remains, it will be impossible to reset the overload, or rather it will reset only long enough for the SCR to conduct again. The circuitry is also such that it is impossible to apply high voltage without the filaments/heaters having been turned on first. Interlock switches are provided for both the power supply and main chassis. It will be noted that these are required to carry only low dc voltage.

As yet nothing has been said about the pilot lamp in series with the control voltage. This bulb serves several purposes – the first is to limit the current drawn from the control voltage source. The source is effectively shorted in the "tripped" condition without it. The second function is to indicate the presence of power to the high voltage control circuit by a dim glow and of a "tripped" condition by lighting to full brilliance.

The relay used here was intended for 12V dc service. It will, however, actuate at around 5V allowing completely normal operation with heater supplies of 5 to 12 ac volts. This relay is similar to those found in Radiosondes and several types of surplus. The original was purchased for $1.50 from a local surplus house. The exact nature of the relay is not critical.

In equipment having one side of the filament of heating winding grounded, that source may be used for the control voltage. When the winding is above ground a small filament transformer must be added for this purpose.

The circuit as described is capable of adjustment from 150 mA to well over one ampere. Increased sensitivity may be accomplished by installing a lower voltage zener diode or the current sensing resistor may be increased in value.

The parts are inexpensive, readily available, and not at all critical. The original cost $3.18. It was mounted on a PC board measuring 2 x 2¼ in. This is definitely not a requirement, and in fact is not even desirable in view of the extreme simplicity of the circuit and the "one of a kind" nature of the project.

Calibration is very straightforward. First disconnect the high voltage transformer primary from the power line as a safety measure. A source of low voltage dc (battery charger or bench supply) is connected in series with the current sensing resistor and an ammeter. Adjust the current to the desired trip point by adjusting the applied voltage or the resistance in series with the circuit. Advance the sensitivity control slowly until the overload relay drops out. Decrease the current to slightly below the trip point and reset the overload. Again increase the current to verify the setting and make any necessary final adjustment. Remove the test setup and reconnect the power transformer.

If a low voltage relay with larger contacts were available it would be possible to use the overload relay to directly control the transformer primary . . . for financial reasons this was not done. . . .WAØABI

Ray Megirian K4DHC
Box 580
Deerfield Beach FL 33441

Lab type IF/RF SWEEP GENERATOR using IC'S

Just about every kit-type sweep generator on the market starts life out at around 3 or 4 MHz and ends up at 200 MHz or so. This always made analysis or display of 456 kHz i-f amplifier response characteristics a tedious step-by-step plotting procedure or required time out to rig up a temporary gimmick to do the job. No more. The sweep generator to be described here will do the job with ease and precision. Even if you do not intend to duplicate the instrument, you may find parts of it useful for other applications.

The generator covers a frequency range of from 400 kHz to 30 MHz in five bands. It can be operated in the CW mode as well as swept, thus allowing it to be used as an ordinary signal generator. Maximum output is 350 mV p-p across 50Ω. When sweeping, the return trace may be blanked or not, as desired. Two calibrated dials are provided for setting the start and stop frequencies and the maximum sweep width would be the entire band in use. The frequencies covered by the five bands are: 400 to 900 kHz, 850 kHz to 2.3 MHz, 2 to 6 MHz, 5 to 15 MHz and 10 to 30 MHz. Sweep time is variable between 20 ms and 6 seconds per sweep. A step attenuator in conjection with a vernier control provide a maximum attenuation of the output of 120 dB. An input is provided for a post-injection marker system built into the unit. A synchronous ramp with gain control is provided for driving the oscilloscope horizontal sweep. Blanking pulses are also brought out to a connector in case they are needed for synchronizing external equipment.

A New IC

The heart of the generator is a new Motorola IC, the MC1648 emitter-coupled oscillator. It was intended for use in phase-locked loop systems operating in excess of 150 MHz, but may be used in many other applications such as this one. The device provides output of high spectral purity and incorporates an internal agc system which simplifies design of the sweep generator by eliminating the need for external leveling. A buffer amplifier and emitter-follower output are also incorporated on the chip, eliminating the need for external amplifiers. Figure 1 is a schematic of the MC1648 IC. Figure 2 illustrates two methods for tuning the oscillator. The device is packaged in a 14-pin DIP and requires a 5V dc supply. Since it was

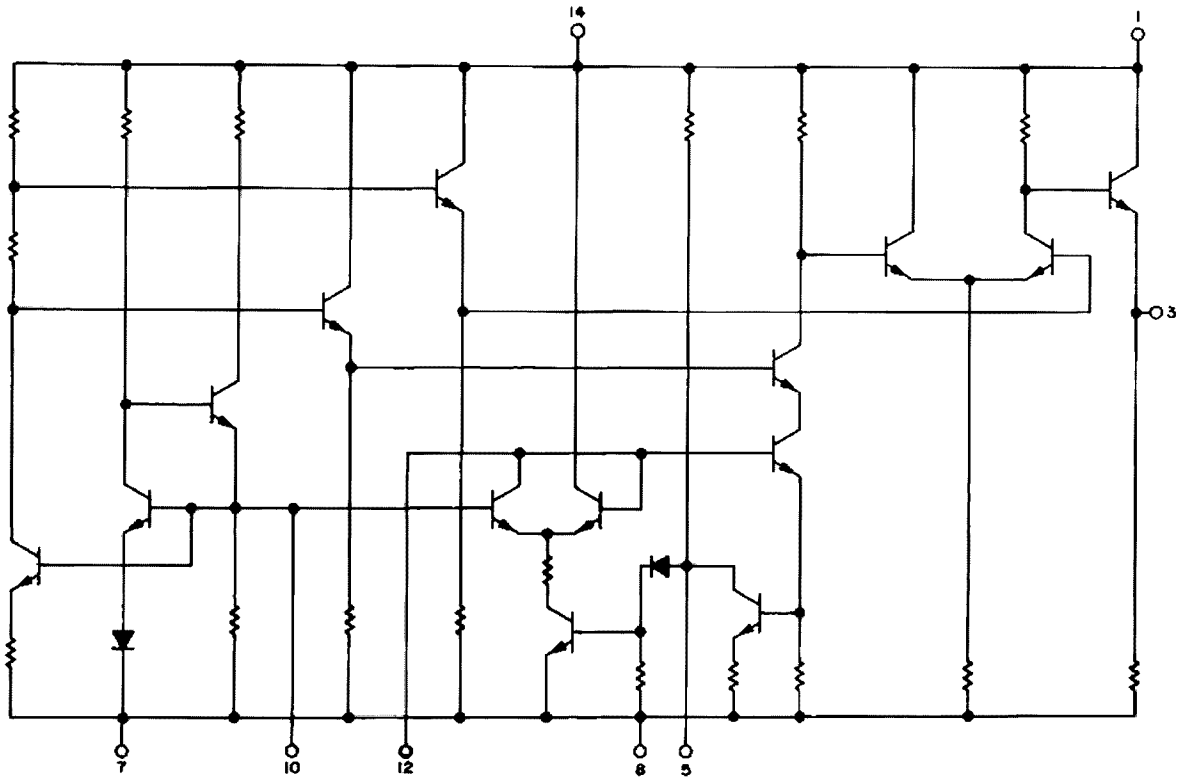


Fig. 1. Schematic of the MC1648 IC.

intended to be used with Motorola MECL III logic, either polarity is permissible. A positive supply is used here, connected to pins 1 and 14 with 7 and 8 grounded.

All the information covered by the data sheet for the MC1648 dealt with operation from 10 MHz up to about 180 MHz. Since I was interested in going as low as 400 kHz, I had to do some experimenting with tank circuits. My best results were obtained with the use of cup cores for the two lowest bands. I also found that ordinary molded iron core rf chokes of the miniature variety did an excellent job the rest of the way. Use of these tiny components made possible a very compact 5-band assembly.

The VCO

In order to facilitate shielding and simplify construction, electronic band switching is employed. Figure 3 is the schematic for the rf portion of the generator. The 2N4391 J-FET has a low 'on' resistance and works very well as a switch. One of these transistors is placed in series with each tank circuit

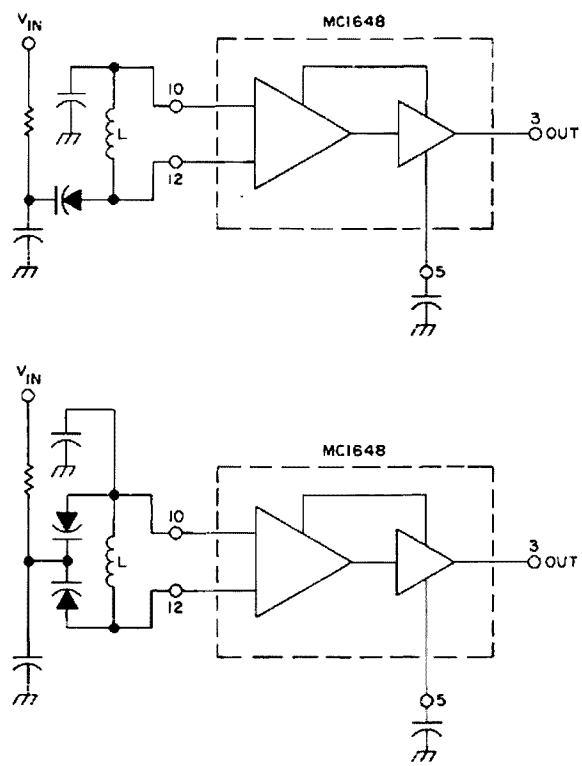


Fig. 2. Tuning the MC1648 with a single diode (A) and using back-to-back diodes (B).



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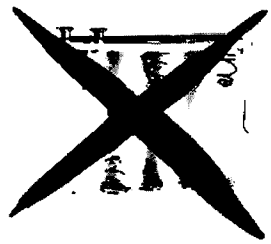
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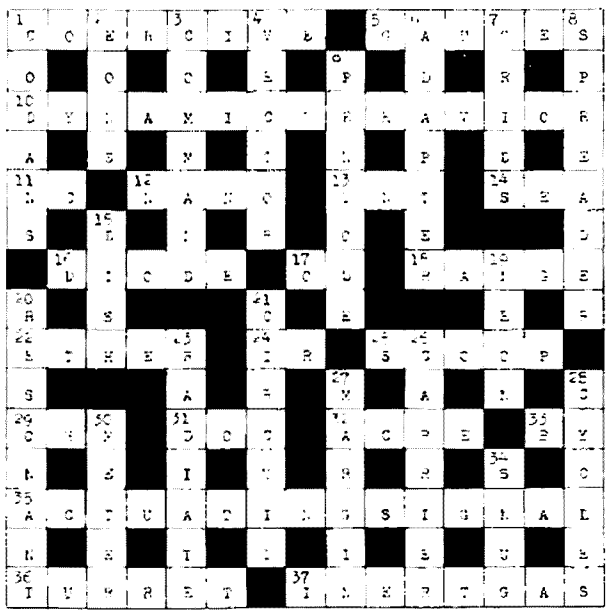
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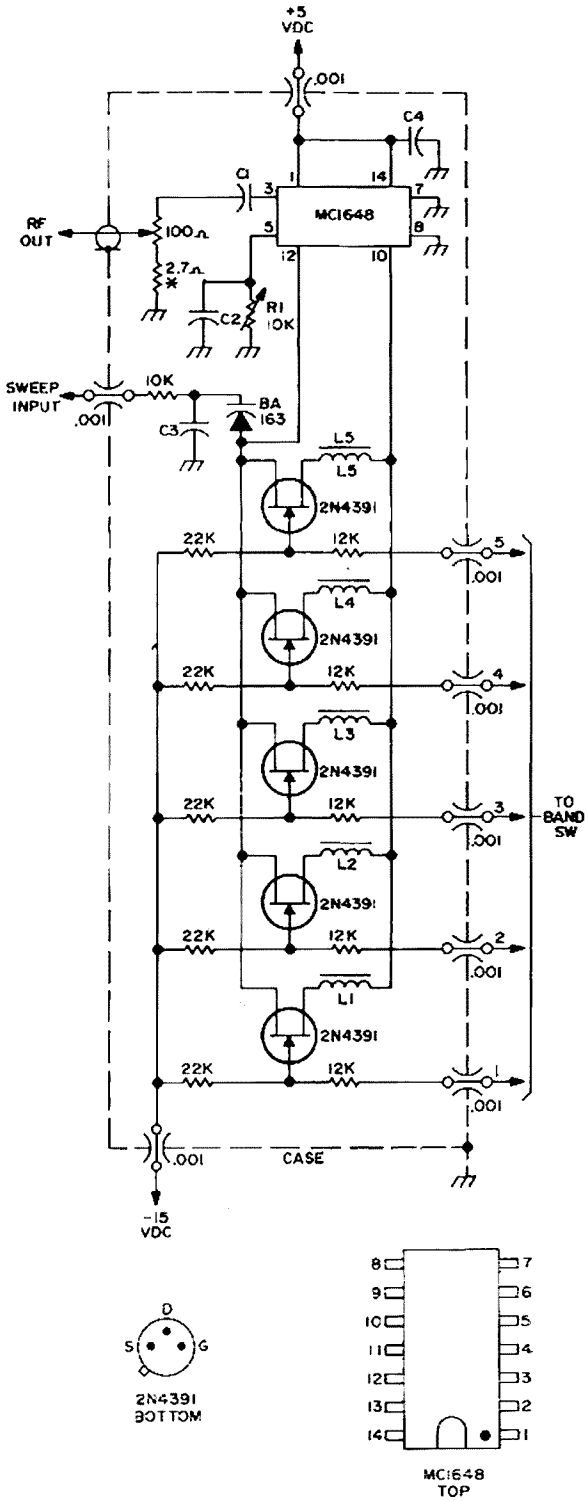
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L4-4.7 μH MINIATURE MOLDED RFC.
L5-1.1 μH MINIATURE MOLDED RFC.
C1, C2 - TYPE 150D TANTALUM-2.2 μF/20V.
R1-BECKMAN 89PR10K 15-T TRIMMER.

* - SELECTED PART - See Text.

Fig. 3. Schematic of the rf assembly using dc band switching.

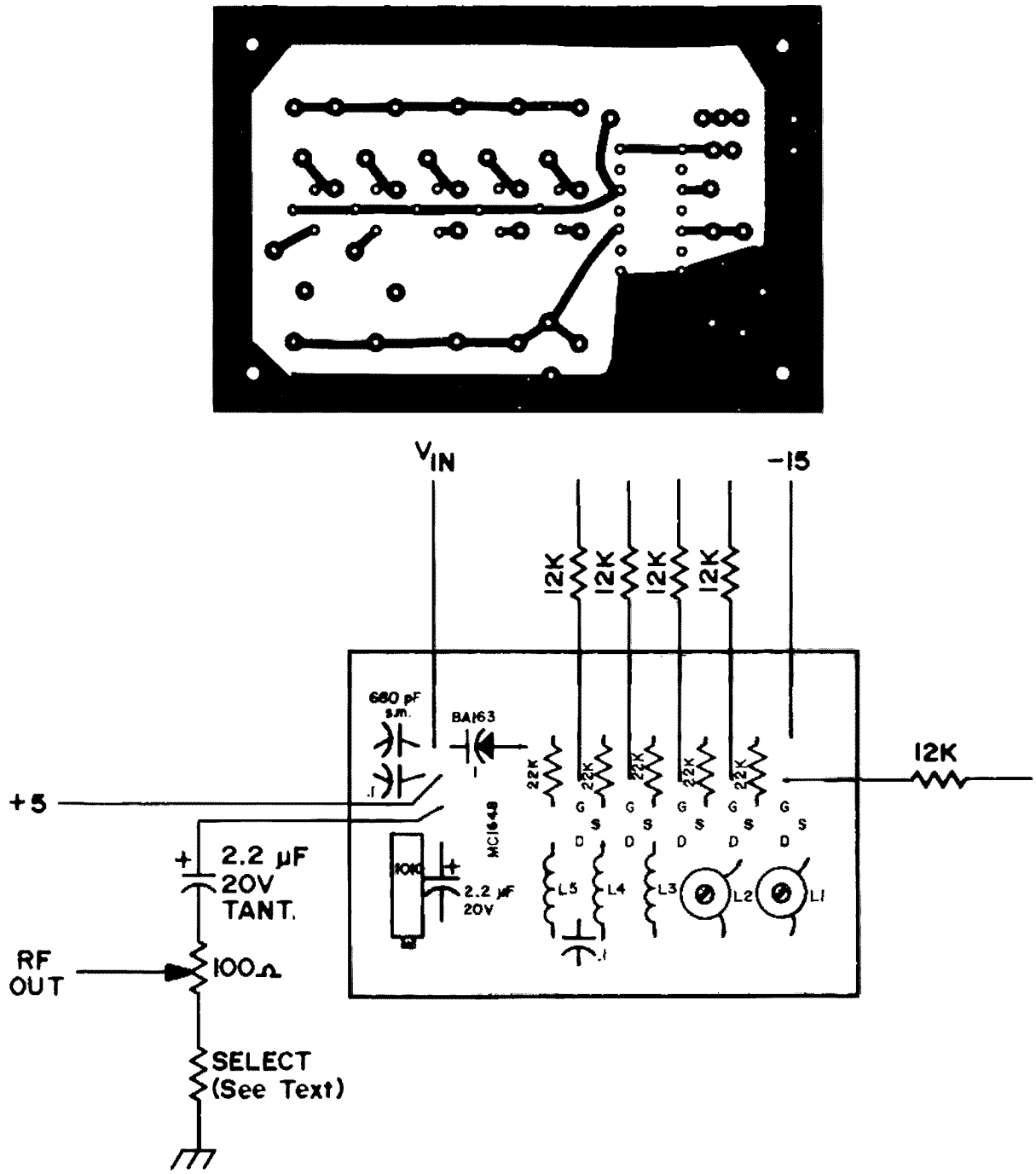
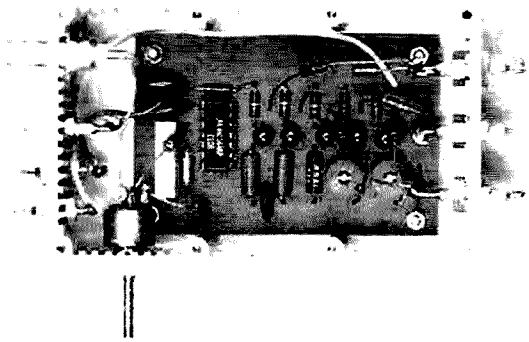


Fig. 4. (A) Foil side of rf pc board. (B) Location of parts on component side.



Completed rf assembly ready for mounting in the cabinet. A plastic version of the 2N4391 was used with a considerable savings in parts cost.

and can be turned on by application of a positive voltage at the gate. This allows the use of a strictly dc-operated remote switching arrangement. The entire assembly is built on a 2 x 3 in. pc board and mounted in a Pomona Model 3306 enclosure with a Model 3328 bottom mounting plate.

A BA163 tuning diode by ITT is used to sweep the oscillator. Although it is intended for bc band use, it performs admirably at these higher frequencies and its high capacitance ratio allows wide sweep excursions. If

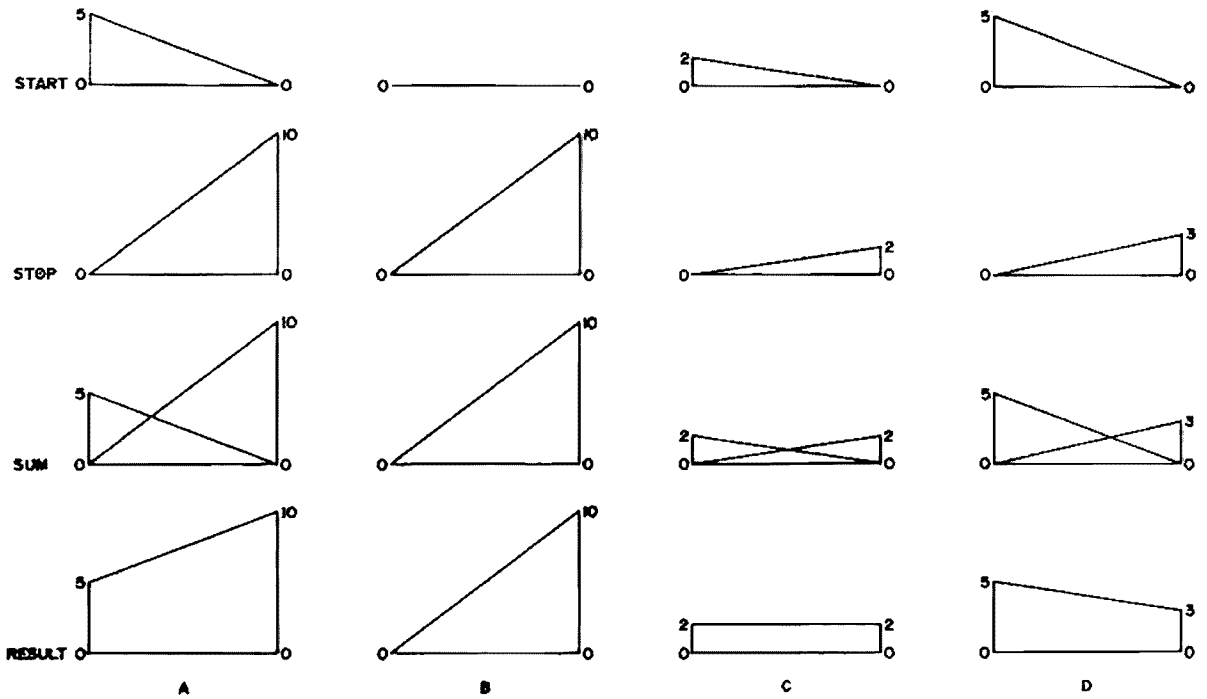


Fig. 5. Pictorial demonstration of ramp generation.

you are planning to use this oscillator for VHF applications, a more suitable diode would be in order. According to the data sheet on the MC1648, typical maximum output frequency is 225 MHz.

The vernier attenautor is a 100Ω RV6 style potentiometer mounted inside the enclosure. A coupling and extension shaft are used to bring the control out to the front panel. The value of the resistor at the bottom end of the pot will have to be selected so that a range of 20 dB is provided with full swing of the control. Since end resistance varies from one control to another, an exact value will have to be arrived at experimentally.

The output from the VCO is a square wave. If sine wave output is desired, the age characteristic may be modified by introducing resistance between pin 5 and ground. The small trimmer incorporated on the board is used for this purpose. It was my experience, however, that this may introduce instability with some MC1648s. Although the trimmer was left in, the one in my unit is turned to maximum resistance where it has no effect and left there. It would do no harm to leave it out altogether since no other changes would be needed.

If any readers are contemplating exact duplication of this generator, you will find the cup cores I used are no longer available. These were Ferrox-cube part number 332P133B4-3C and are obsolete. I had a large number of these on hand left over from another project and saw no sense in buying more. I am sure some of the presently available cup cores will make excellent substitutes. Those used here are about 3/8 in. in diameter and are ungapped. You may have to experiment with the number of turns in the coil to obtain the coverage you require. One handy trick you can pull with a cup core is to rotate the slots in each half so that fractional turns are produced when the coil wires are brought out separately through the two spaced holes. Exerting pressure on the core by means of the mounting screw will also shift the frequency and is almost like having a slug to tune. Increasing pressure seems to raise the frequency. The rf chokes used for the higher bands may also vary slightly from piece to piece and several may have to be tried to get the desired coverage. There isn't much we can do to alter the frequency where the chokes are used. Of course, slug-tuned coils may be used if the pc layout is modified. I do not recommend

their use on the two lowest bands, however, since my results were rather unsatisfactory with this sort of tank circuit.

One final point would be in order before leaving the VCO. Note that the 10 KΩ resistor going to the tuning diode, the 2.2 μF rf output capacitor and each of the 12 KΩ resistors going to the transistor gates are not mounted on the board. One end of each has a hole provided on the board and then the component itself is used to make the connection to its final destination. This saves board space and eliminates separate wires. The small resistor at the bottom of the vernier attenuator is similarly mounted between the board and the bottom lug on the control. These points are more clearly seen in the photo. Also note that the cup cores are fastened directly to the board by means of 1-72 screws into threaded holes.

The Ramp Generator

In contrast with kit-type sweep generators that use the 60 Hz line for sweeping the oscillator, laboratory instruments have internal circuitry designed for this purpose. In our case, as with most sweep generators, a voltage ramp is used to control the oscillator during the sweep period. The circuitry has been arranged so that we can adjust the starting point (dc level) of the ramp independently of the stopping point. This simply means that we can set the frequency at which the sweep starts as well as the frequency at which it stops. We can also control, over a fairly wide range, the time it takes for a complete sweep. In this case, the sweep time is continuously adjustable between 20 ms and 6 seconds per sweep.

To get a better idea of how the ramp generator produces the results we've described above, let's look at Fig. 4. Note that a negative-going linear ramp (start) is combined with a positive-going linear ramp (stop) to produce the resultant ramp being applied to the varactor diode. If either input ramp is zero, the resultant will be the same as the single ramp since adding zero to anything will not change its value. Naturally, if both are zero, the output will be zero and

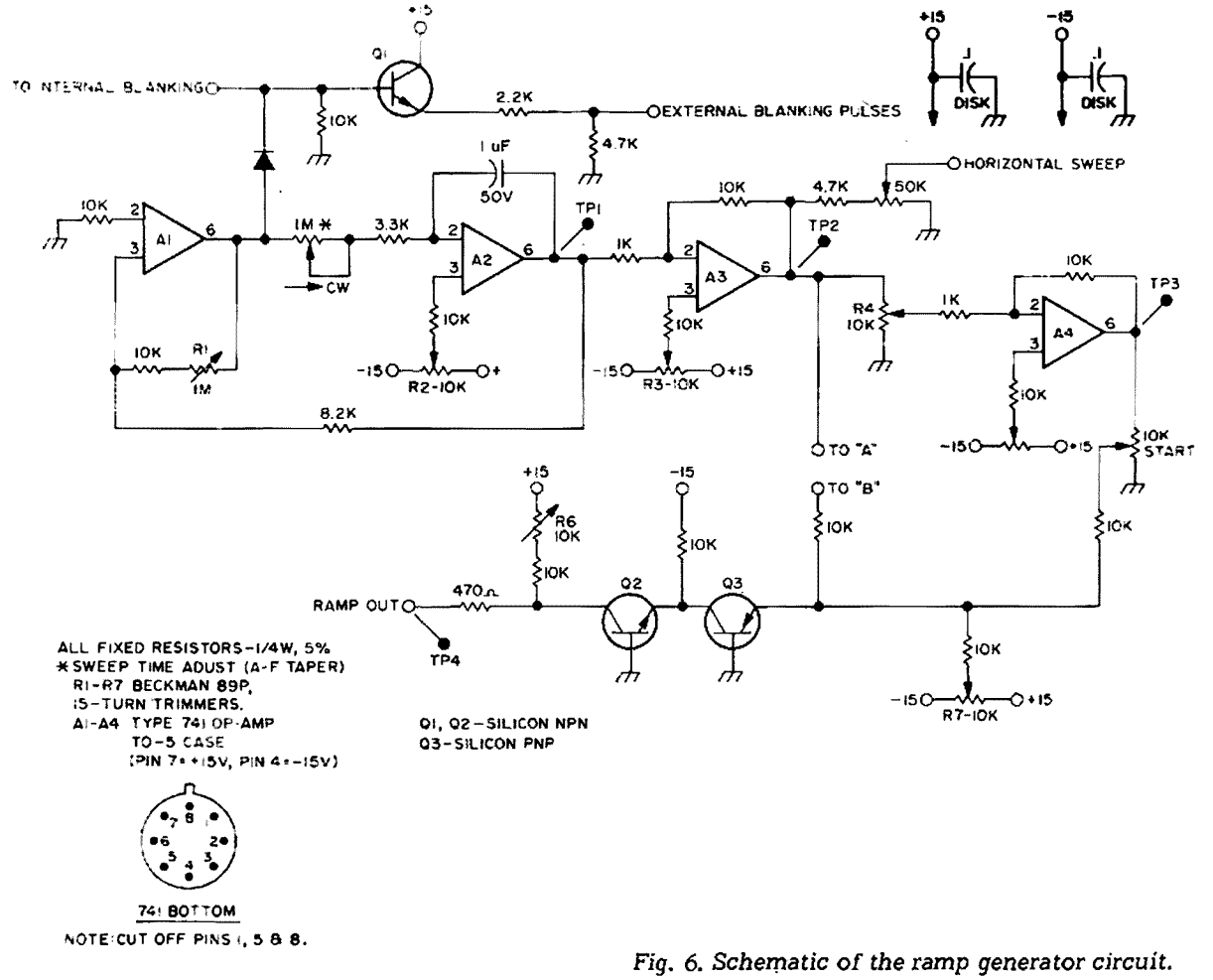
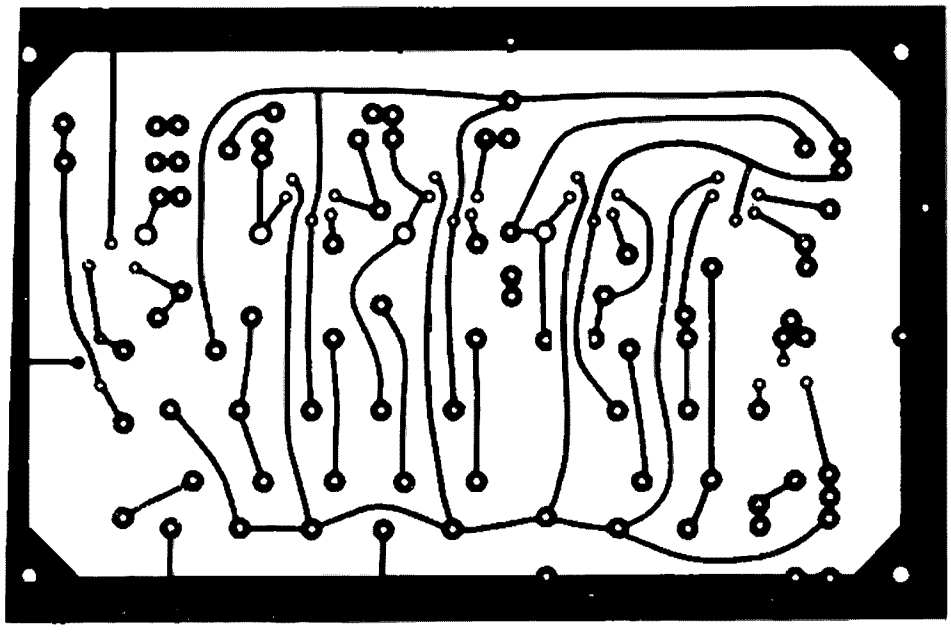


Fig. 6. Schematic of the ramp generator circuit.



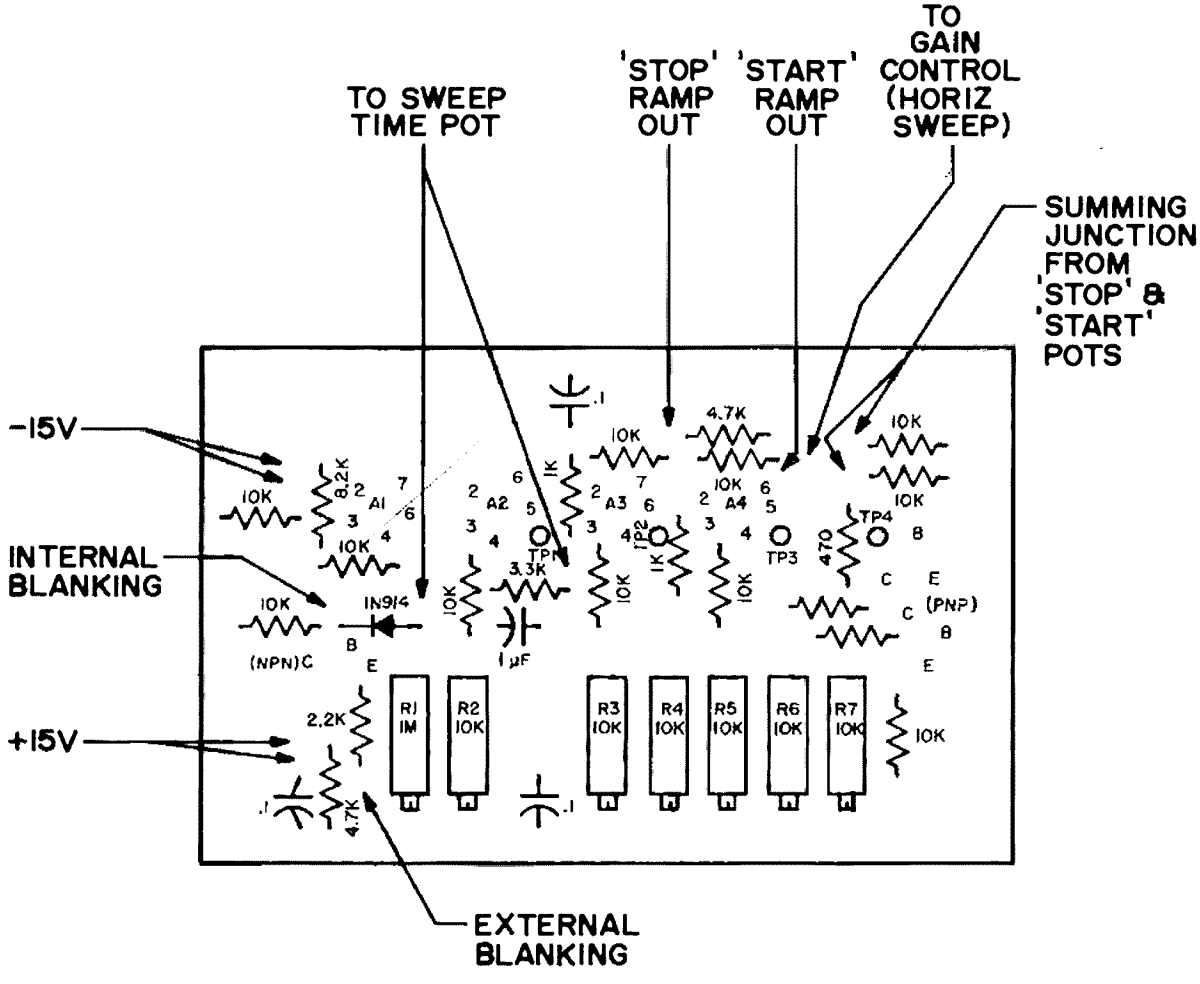
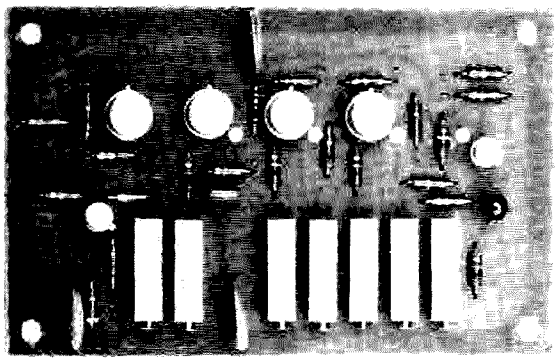


Fig. 7 (A) Foil side of ramp generator board. (B) location of parts on component side.

the oscillator output frequency will be constant during the sweep period. The same is true whenever both ramps are of equal amplitude, except that the output will be a steady voltage other than zero. Alsc note that the resultant ramp could have a negative slope if the 'stop' input is lower than the 'start' input, and the oscillator would ob-



The ramp and blanking generator pc assembly. The leads going to external points will go in the holes visible on the board.

viously sweep down in frequency rather than up.

The schematic for the ramp generator is shown in Fig. 5. Operational amplifiers A1 and A2 form a triangle wave generator with A1 acting as a threshold detector and A2 as an integrator. One half of the triangle (negative-going) represents the sweep period while the other half represents the retrace time. Since a square wave is generated at the output of A1, we have a convenient source of blanking voltage built right in. This signal is positive during the sweep period and is connected to the band switch when Swept I (blanked retrace) operation is selected. During retrace the square wave drops to zero and actually disconnects the tank circuit until the next sweep starts. An emitter-follower, Q3, buffers the square wave output for external use.

The output of inverting amplifier A3 is a positive-going ramp during the sweep period and is used for both the 'stop' signal and horizontal sweep for the oscilloscope. Since an additional inversion takes place in the output of A4, the negative-going ramp at this point is used as the 'start' signal. These two ramps are applied across front panel controls which have 6:1 reduction drives and are fitted with dials calibrated in frequency for the five operating bands. The outputs from these two pots are fed to summing amplifier Q1, where the output will be the resultant ramp we discussed above. Because the output Q1 is in the negative region (PNP

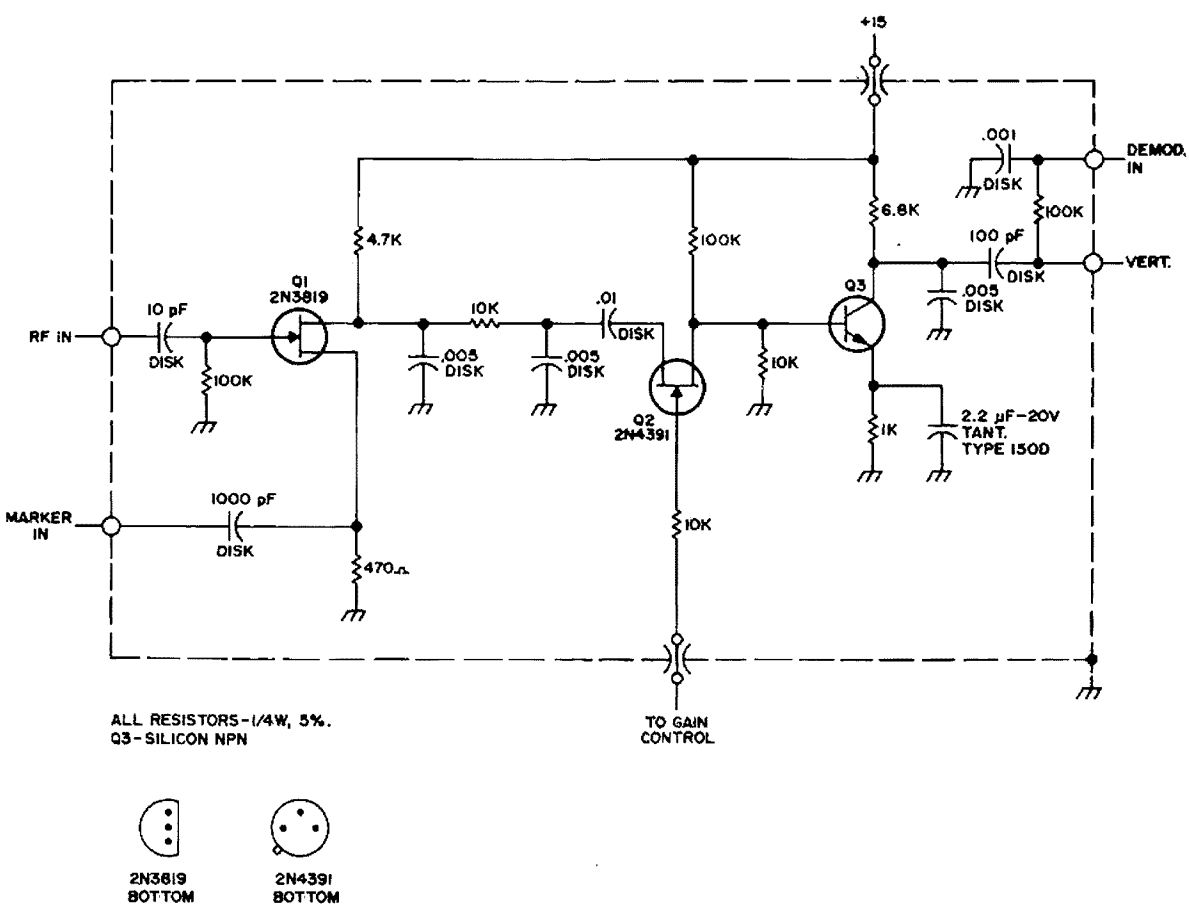
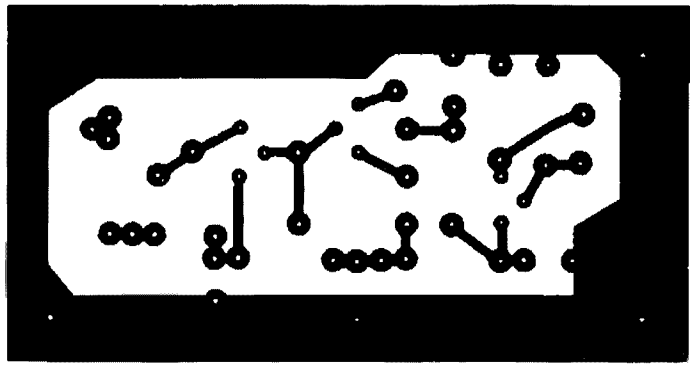


Fig. 8. Post-injection marker circuit with dc gain control of marker size.



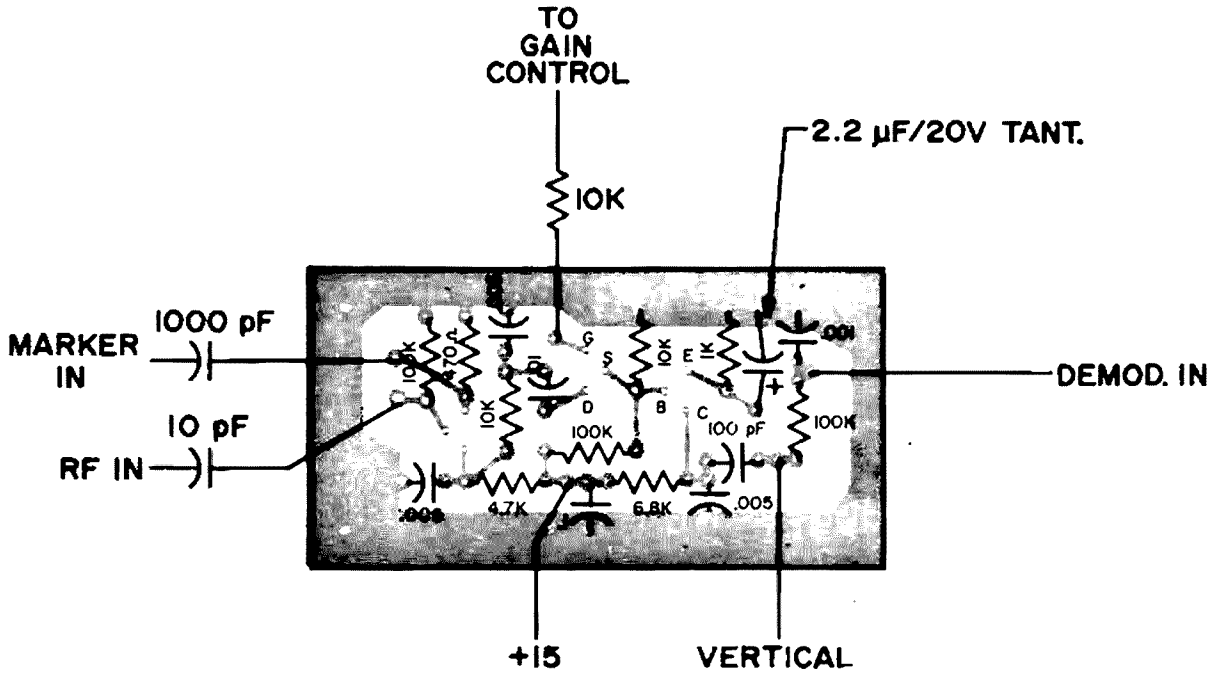


Fig. .9. (A) Foil side of mixer/amplifier pc board. (B) Location of parts on component side.

transistor), a second common-base (NPN) amplifier is used to shift the output back to where it will always be positive.

The ramp and blanking generator is constructed on a pc board 2.6 x 4.1 in. in size. For convenience, all the trimmer resistors were mounted along one edge. As seen in the photo, this board was mounted by means of two small brackets in a vertical position with the trimmers facing up. To simplify pattern layout, unused pins 1, 5 and 8 on each of the four 741 opamps were clipped off right at the case. Color-coded wires were connected to all necessary points on the board before it was mounted, with the leads made long enough to reach their destinations. For those interested in building this unit, a detailed procedure for setting up the ramp generator will be given later.

The Mixer/Amplifier

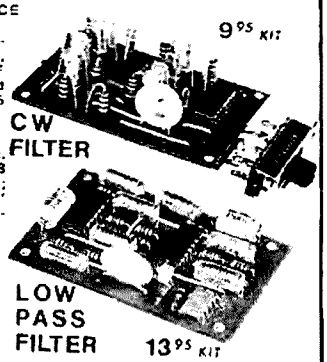
In order to provide a means for displaying frequency markers, a mixer and amplifier circuit was built into the sweep generator. The schematic for this circuit is shown in Fig. 6. A marker generator was not included inside the sweeper because other rf generators were available for use as markers and the added expense seemed unnecessary. Because the mixer board was to be installed inside a shielded box, dc gain control was resorted to as with the band switching discussed earlier. A 2N4391 is used as a variable resistor to control the signal input to the amplifier stage. This in turn controls the size of the marker being displayed on the curve. A 2N3819 FET is used in a simple mixer circuit which worked the best of several tried. Incidentally, the PNP and NPN

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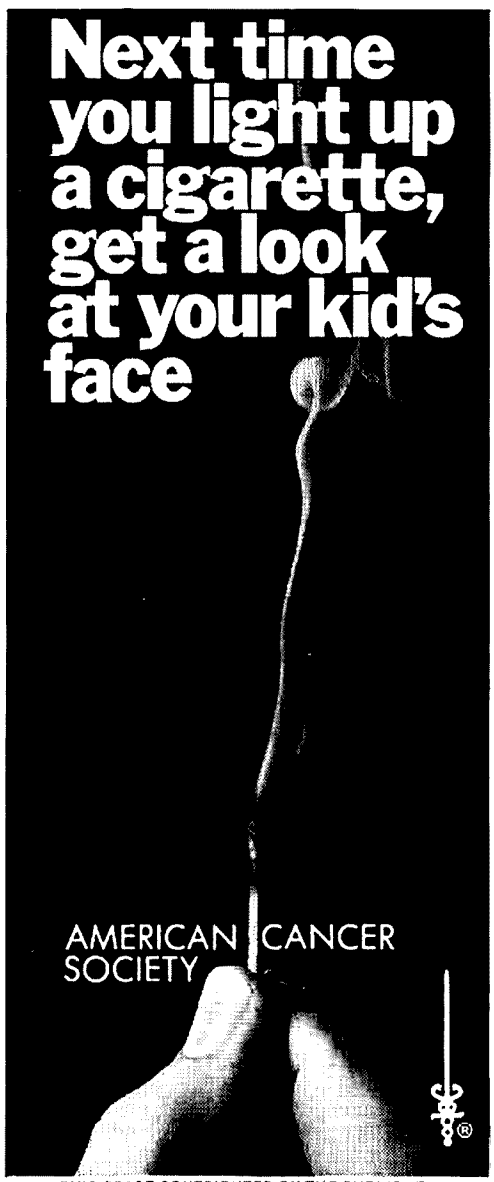
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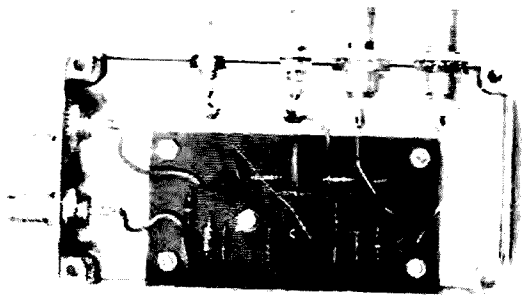
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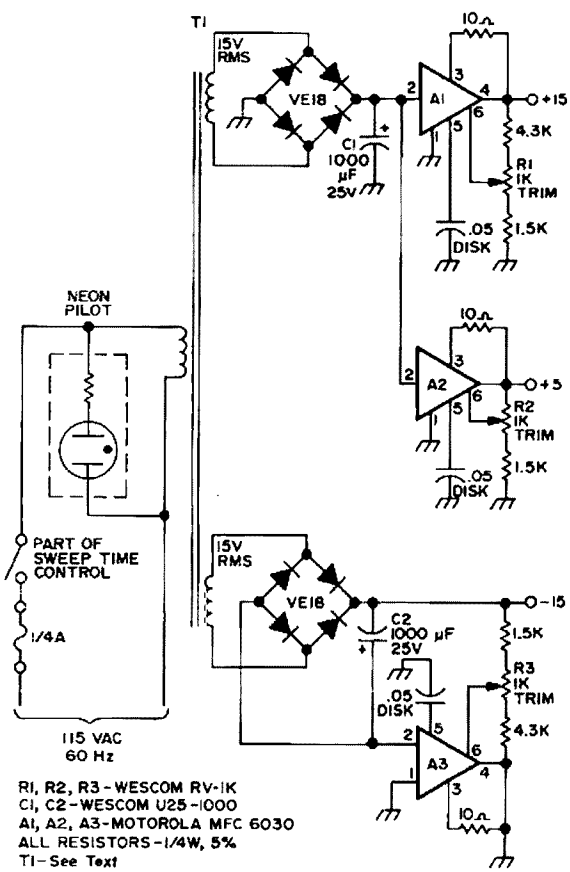
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Completed mixer/amplifier board mounted in the die-cast housing.

transistors used here and on the ramp generator board are unknown surplus silicon units.

The pc board for the mixer is 1.5 x 2.9 in. and is mounted in a Bud CU-124 die-cast



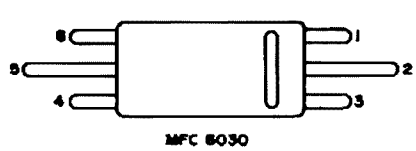


Fig. 10. (A) Foil side of power supply pc board. (B) location of parts on component side.

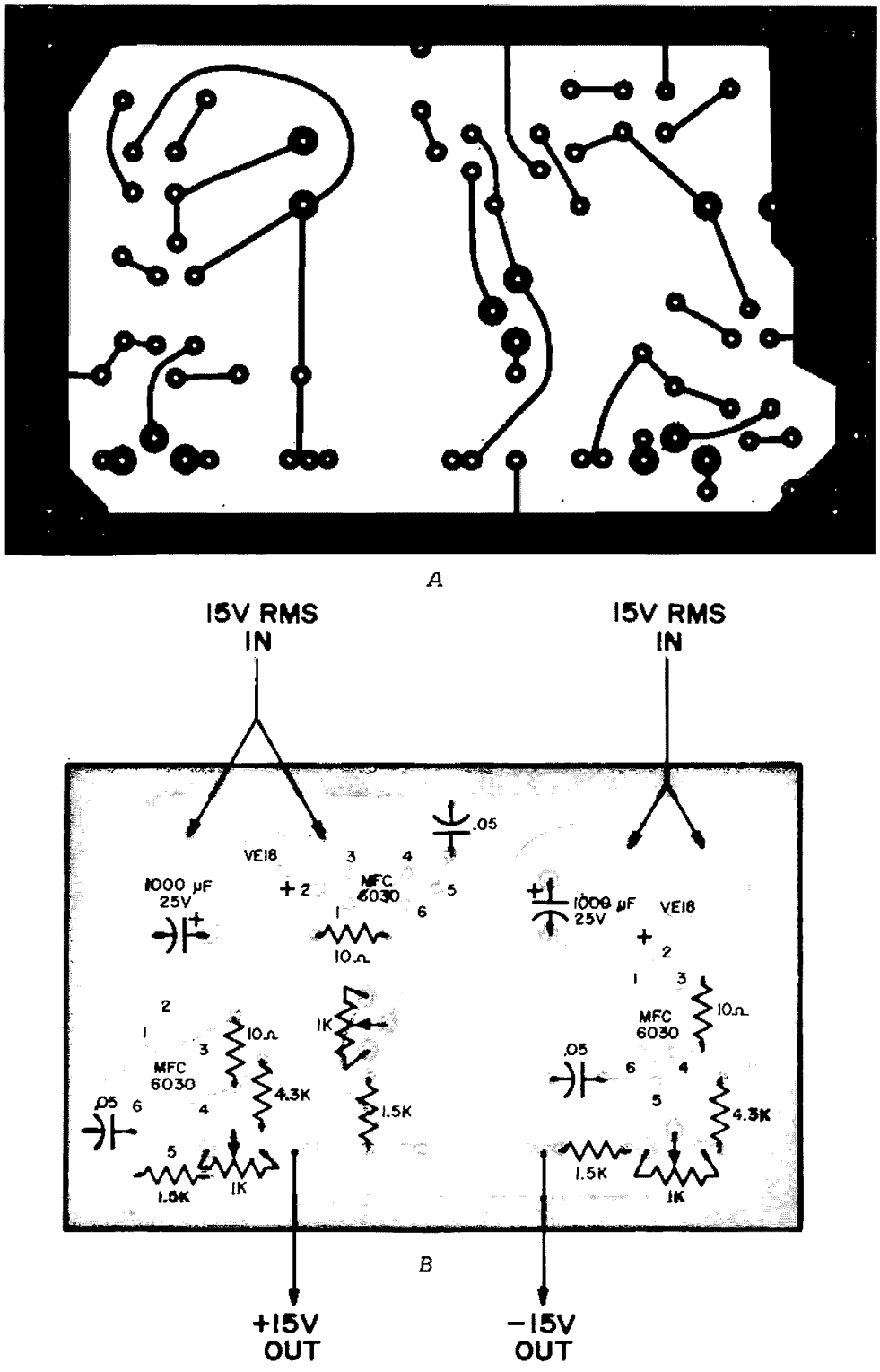


Fig. 11. (A) Foil side of power supply PC board. (B) Location of parts on component side.

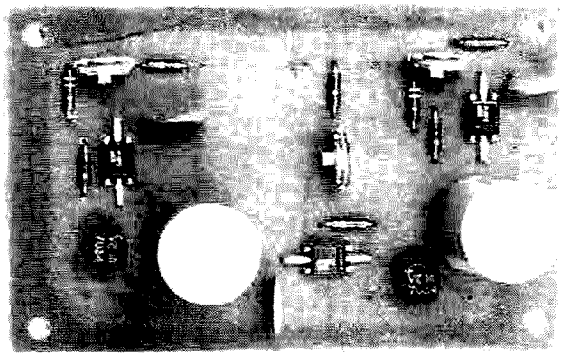
aluminum box. Note that here again some of the components are mounted between the board and their external connectors. These include both the 10 pF and 100 pF input capacitors to the 2N3819 and the 10 KΩ resistor going to the gate of the 2N4391.

The Power Supply

Figure 7 is a schematic for the power supply. Voltage requirements for the sweep generator are +15V, −15V and +5V dc. The current drawn by any of the above circuits runs no more than 30 or 40 mA maximum,

making the use of small IC voltage regulators ideal. Motorola MFC6030 (plastic) regulators are used in each supply and are overload protected against accidental short circuit. Varo type VE18 molded bridge rectifiers, together with 1000 μF filter capacitors, supply the dc input to the regulators. The +15V and +5V regulators are both fed from the same source. The power transformer was a surplus unit with a 30V CT secondary. The center tap was uncovered and the two leads separated so as to provide two independent 15V windings. A small trimmer is provided in each supply for voltage adjustment.

The pc board for the power supply is 2.6 x 4.1 in. All components but the transformer are mounted on the board. The transformer is mounted directly on the chassis. Relative placement of the various components making up the complete generator can be seen quite clearly in the photo.



The power supply pc assembly.

Control Circuits

Figure 8 is the wiring diagram for the control circuitry. Note that for CW operation of the generator, a dc voltage is applied to the varactor by way of the Start pot. In order for the dial calibration to be valid in either mode, the dc level applied to the control must be exactly the same as the peak amplitude of the ramp during swept operation. As will be explained in the set-up procedure, the ramp will vary from a starting point of approximately +1.4V and peak at +12V. Resistor R1 in series with the +15V line is selected for a +12V level at the high end of the pot. R2 is selected for a level of +1.4V at the low end. The reason for the offset of 1.4V at the low end is because the

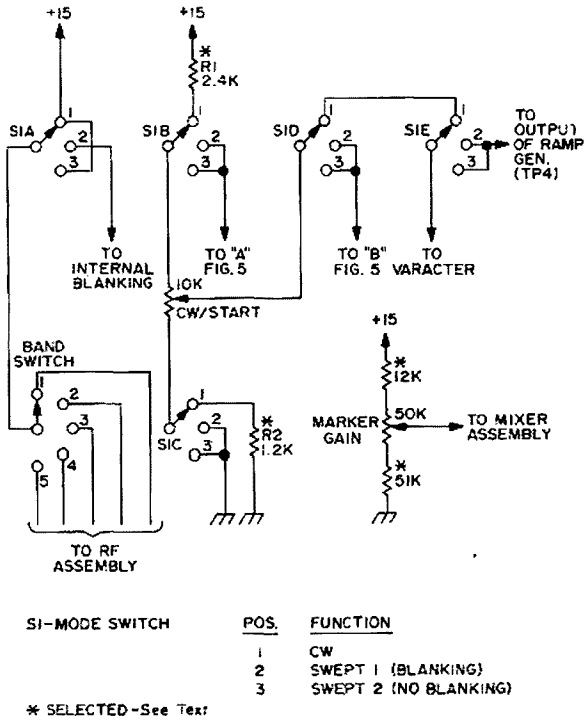


Fig. 12 Control circuit wiring schematic.

pin to which the tuning diode is connected at the MC1648, sits at this level. The source of this bias is the drop developed across two forward-biased junctions within the IC and not from any external source. Once these dc levels have been set for CW with the fixed resistors, the ramp can be made to match by means of the trimmers in the ramp generator circuit.

The rest of the control circuitry is quite straightforward. In position 2 (Swept 1) of the mode switch, positive pulses from the ramp generator are fed to the band switch during the sweep period. When retrace occurs, the pulse drops to zero and the oscillator shuts off until the next sweep starts. In the CW and Swept 2 positions of the mode switch, a steady +15V is applied to the band switch and the oscillator runs continuously.

The final function performed by the mode switch is to route the dc for CW or the ramp for swept operation to the tuning diode. The two fixed resistors are mounted point-to-point behind the panel since all points are readily accessible within every short distances. The fixed resistors associated with the marker gain control are also

mounted the same way behind the panel. The switches are ordinary rotary types and the potentiometers are all ordinary carbon controls. The Start and Stop controls as well as all gain controls have linear tapers. The Sweep Time pot is an audio taper type with built-in switch for ac power.

Setting Up the Ramp Generator

For best results, a calibrated dc scope is required to properly adjust the ramp generator. Test points have been provided on the pc board and short pieces of bare wire connected to each of these points make excellent tie points for the scope probe. The circuit may be aligned either before or after installation. The Start, Stop and Sweep Time pots can be connected at the ends of their respective leads if the unit is checked outside the cabinet.

Set all seven trimmers to mid-range. Connect the scope to TP1 and adjust the horizontal for a full sweep of 20 ms. Set the Sweep Time control to minimum resistance and apply power. Some sort of triangular wave should be displayed. Adjust R1 for a 3V p-p amplitude of the waveform. Turn R2 cw until the negative-going portion of the triangle is 20 ms long. Since R1 and R2 interact, you will have to stop occasionally and reset R1 for proper amplitude. Once the ramp is set at 20 ms with the Sweep Time pot at minimum, the slow speed end will automatically be about 5 or 6 seconds with a 1 MΩ pot.

Transfer the scope probe to TP2 where a positive-going ramp should be seen. Set the starting point of the ramp to zero volts by means of R3. Amplitude of this ramp must be 10V. If it is not, go back and adjust R1 slightly until it is. If necessary, reset R2 for 20 ms trace length. As soon as a 10V, 20 ms, zero-based, positive-going ramp has been achieved at TP2, go on to TP3.

At TP3 there should be a negative-going ramp. Once again we require a zero base line or starting point. Adjust R5 to accomplish this. Amplitude should once again be 10V and is controlled by R4. Once you have a 10V, zero-based, negative-going ramp, move on to TP4.

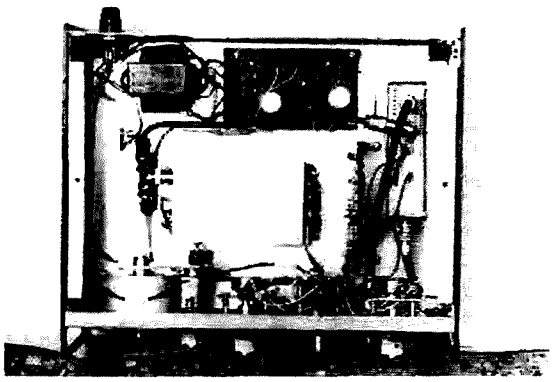
Connect the probe to TP4 and set the Stop control to full cw. The Start pot should be at minimum setting. A positive-going ramp should be present at TP4. By means of trimmer R7, move the ramp up or down until the starting point is approximately +1.4V. Ordinarily the ramp will not go below zero but will flatten out as the positioning control is adjusted. This is due to clipping in the output amplifier. If the ramp generator is going to be used with another type of VCO, the ramp can be set to exactly zero if desired. In our case we can't as explained previously.

Because a substantial amount of capacitance change occurs in the tuning diode up to 12V, the final ramp amplitude is set to 12V by means of R6. Because R6 stretches the signal in a negative direction, R7 will have to be used to reset the base line at 1.4V. Other than for checking tracking between the CW and swept modes, this completes the alignment procedure for the ramp generator.

When the generator is finished, you can check the tracking by observing actual signals at the input to the VCO. Connect the scope probe to the feedthrough capacitor on the VCO assembly that goes to the tuning diode and set the Start control to maximum. Switch rapidly between the CW and Swept 1 positions of the mode switch. The CW input will be a straight line sitting at +12V while the swept input will be a ramp peaking at +12V. Next, turn the Start control to minimum and again compare levels. If the Stop control is also at minimum, both signals will be straight lines at +1.4V. If there is any substantial difference between the two modes, use R6 and R7 on the generator board to make the ramp agree with the dc levels. That completes all phases of the ramp set-up procedure.

Construction

The cabinet used here is one manufactured by Sorensen Electronics in their Mod-U-Line series. These are the most reasonably priced instrument enclosures I've come across so far and I've used them for several projects. This one is a Model MCH-5129 with a CP-129 chassis plate.



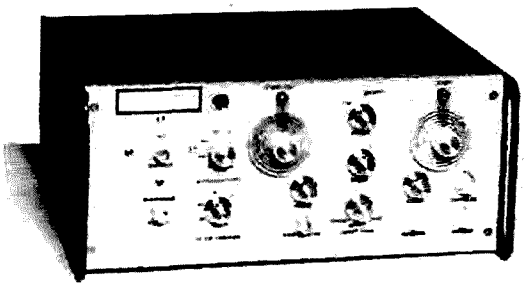
This bird's eye view of the interior shows the location of all major assemblies.

Total cost of the enclosure is around $22. Dimensions are: 5¼ in. high by 12 in. wide by 9 in. deep.

The 5-step attenuator was picked up surplus from Fertik's Electronics for about $10. It is well made and designed for 50Ω systems operating up to 1 GHz. It has an integral female BNC output connector on the front face along with four threaded mounting holes for ease of installation. The input connector is a BNC male at the end of a short piece of coax.

All rf assemblies are interconnected inside the cabinet by means of coax cables. This is clearly evident in the photo.

The Start and Stop pots were mounted on brackets behind the front panel so that Jackson Brothers type 4511/DAF reduction drives could be installed for easier tuning. The two circular dials are slightly under 2 in. in diameter and were cut from sheet plastic. While operating in the CW mode, one of these was calibrated in pencil to provide a pattern for the finished product. A master



The finished sweep generator makes a professional appearance.

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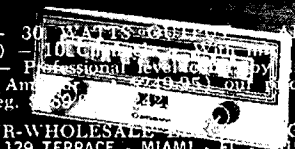


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was laid out using Rubylith® film and rub-on numbers. A negative of this was then made using 3M reversing film. From the negative a finished set of dials was printed on aluminum material of the presensitized variety. These were cut out and stuck to the plastic by means of their own pressure-sensitive adhesive backing. The nameplate was made from the same material. The two index pointers are clear plastic with hairlines scored on the inside surface. They are mounted on spacers directly over each dial. All remaining labeling was done with tub-on lettering.

Summary

It is assumed that anyone contemplating construction of an instrument like this is thoroughly familiar with the use of sweep generators so no instructions will be given here. You should find the generator quite useful for making narrow sweep displays such as those for filter response. The ability to control sweep speed is an asset where slow speeds are required. Although only one marker input is provided for, a comb is sometimes useful and can be generated by your crystal calibrator or other square wave source and fed into the marker input. Input level to the mixer should be kept below 100 mV in general since no input gain control is provided.

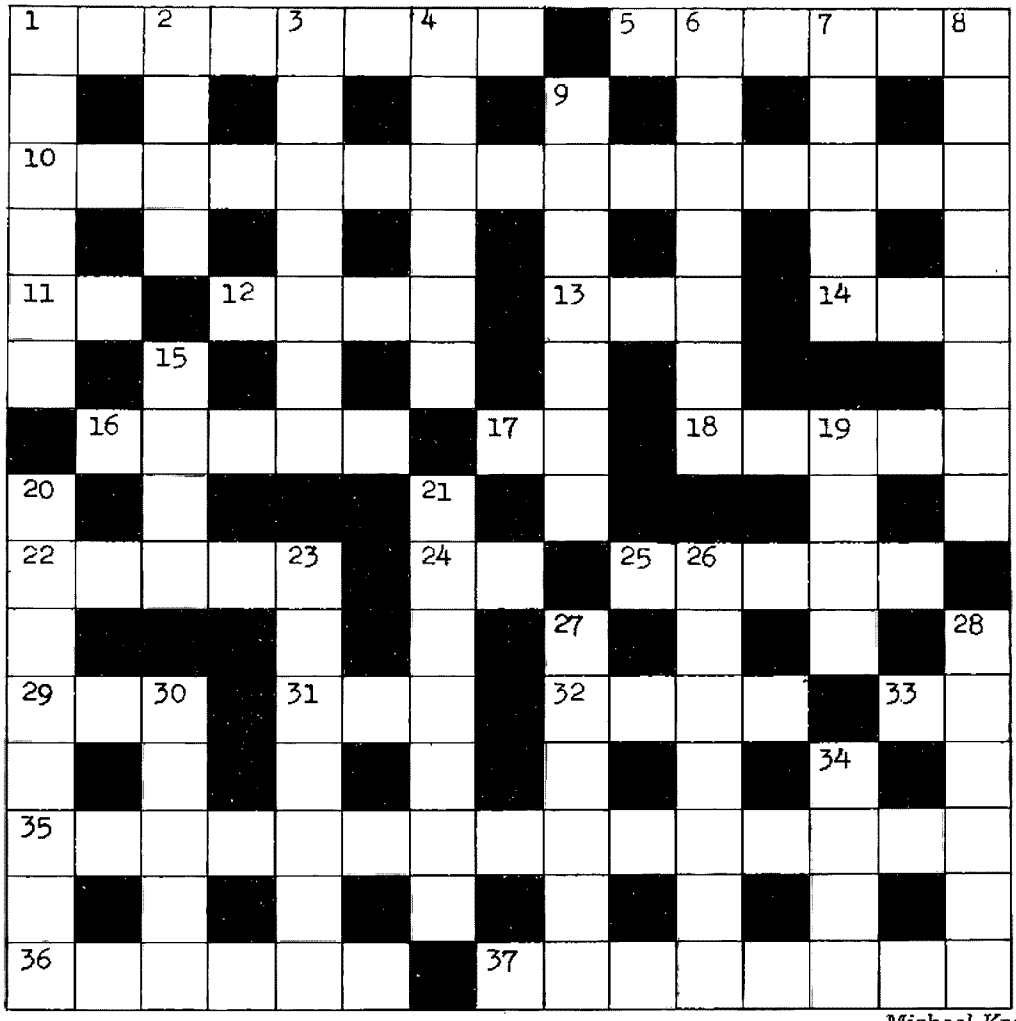
Purchasing parts is often one of the greatest problems encountered with a project of this nature. In some cases, as with Wescom, minimum billing is a way of life and makes small purchases nigh impossible even though the eventual per piece price is very low. Since I generally buy in larger quantities than needed, I may be able to help out with some of the parts if any of you are really desperate. At any rate, I hope you have found this worthwhile, and to those of you who plan to build the sweep generator – best of luck. . . .K4DHC

Vendor Addresses:

Fertik's Electronics, 9th & Tioga Sts., Philadelphia PA 19140.

Sorensen Electronics Co., Inc., 418 Queens Lane, San Jose CA 95112.

Wescom, P.O. Box 2436, El Cajon CA 92021.



Michael Kresila
Box 57
Marion OH 43302

ACROSS

1. The amount of opposite magnetomotive force necessary to eliminate residual magnetism.
5. Devices used for determining whether a specified dimension is within specified limits.
10. Describes how a control system or an individual unit carries on with respect to time. (2 wds).
11. No Connection. Abbr.
12. Prefix meaning one-billionth.
13. Explosive.
14. Body of water.
16. A device having two electrodes, the cathode and the plate.
17. Outside dimension. Abbr.
18. The maximum useful distance of a radar or radio transmitter.
22. The medium that was once supposed to fill all space and through which radio, heat, and light waves were supposed to travel.
24. A type of loss.
25. A ladle.
29. Unit of electrical resistance.
31. Document. Abbr.
32. Measure of land.
33. Near.
35. In control systems, the reference input minus the primary feedback.
36. A revolving plate mounted at the front of some television cameras carrying two or more lenses, for rapid interchange.
37. One of a group of gases that will not combine with another element (2 wds).

DOWN

1. A squelch circuit. (P1) 2. Indefinite periods of time. 3. A signal which initiates or triggers an action in the device that receives the signal.
4. A quantity having magnitude and direction.
6. A fitting designed to change the terminal arrangement of a jack, plug or socket.
8. The crossarm separating the parallel wire elements of an antenna.
9. A five-electrode electron tube.
15. A microwave antenna, usually shaped like a parabola.
19. Inert gas used in some electron tubes.
20. Increasing the intensity of sounds.
21. An electronic path between two or more points capable of providing a number of channels.
23. To emit rays from a center source.
26. A wave of constant amplitude, frequency, and phase which can be modulated by changing amplitude, frequency, or phase.
27. The difference between an actual operating point and the point or condition where a failure to operate properly will occur.
28. An off-on application of power.
30. Instrument used formaking electrical measurements.
34. Tight fit.

Solution page 228

LETTERS CONT.

Some time ago, when I wrote you in the context of "Caveat Emptor," I agreed with myself that it was my last excursion into the controversial world of amateur radio. Tiling with windmills can be pretty exhausting, as Don Quixote discovered, and the quasi-independence of various amateur groups makes conciliatory efforts equally debilitating; if not more so.

However, as I see another divisive tempest brewing among amateurs, this time in the FM repeater ranks, I cannot in good conscience ignore it. At least without pointing out that the present conflicts are symptomatic of the very actions that lost much of the available space, in other bands, for us. And with more emphasis, has helped to persuade the FCC that we can't get together, don't know what we really want, don't use what we have — all to the end of more regulation and fewer privileges.

Now we see the familiar dog-eat-dog pattern developing in the relatively sophisticated (technically) world of the FM repeater. Courtesy and conciliation seem again to be unknown quantities in the ham world, insofar as promotion and operation of repeaters in general is concerned. I'm sure that most users, like myself, try to remember that there may be others "waiting on the line," and so keep an ear out for breakers. But I've already heard the type of stuff that pretty much ruined phone for most of us on 20 and 75. And now it seems that the brute force output philosophy is being applied to repeaters.

So I suppose this is a plea for maturity in judgment and for common sense in approach. Surely we all understand that there are no private frequencies or coverage areas. Surely we are sufficiently advanced in techniques — either with respect to antenna patterns or with respect to triggering — to find ways and means to reduce QRM between repeaters to a minimum.

Let's not drop the ball *this* time! Hell's bells, if the associations and individuals concerned will only get together on a non-power-politics basis, we can stop the fragmentation and begin to achieve cohesion. And realize the real potential of FM repeaters.

Al Smith W1GAA/K3ZMS

Well, Al, I have a feeling that your erudite and polite request which is aimed at a select few will not get their attention. They are much too involved with the alligators snapping at their ass, which is an apropos expresssion for repeater squabbles.

One of the functions of the Repeater Bulletin — actually one of the major functions in my view (and the Bulletin is obviously an expression of my view, though more by default than intention — if others would learn to express themselves in writing as well as they do with amplifiers and insulting remarks on repeaters I think that more progress could be made) — oh, yes, the Bulletin function is to throw light on bad situations as they develop with the hope that the scurvy characters who are working so diligently to make things miserable for others would scurry away from the light.

If you get on the air and use the repeaters quite a lot, Al, you'll find that the battles in our ranks are, in perspective, quite minor. Perhaps the reporting of them in detail in the Bulletin has made them seem more important than they are. Listening to one or two repeaters can give you a biased perspective — like the Marcus-ARRL machine KGQ could give someone a very bad idea of how things are — ditto the KHB machine in Weston. I doubt if you'll hear much negative on many of the other repeaters.

You should keep in mind that, all in all, repeaters in New England are so far ahead of the rest of the country that our situation is a model for the whole world. This does not mean that we can't improve or that we should stop trying to clean up the little pockets of childishness that are bothering us.

May I take issue with you regarding the "ruined" 20 and 75 meter bands? The only big problems that I see with these bands are the General Class segments which are generally horrible. Even with a BIG signal I find these parts of the band depressing and I head back for the QRM-free two meter repeaters.

There are times when the Advanced portion of these bands gets filled up, but for the most part I find little difficulty in making contacts with about the same level of QRM as I have been used to for all of the sideband years. When I remember back to the old AM days I am ever thankful — for there is no comparison.

I do not think that the FCC did the amateurs any favors at all when they established the split phone bands. It obviously has had little effect in getting amateurs to change their grade of license. I suspect that this has helped FM to grow — perhaps a lot more than suspected. The intensive QRM of the General part of 20m is enough to get anyone to think in terms of looking for something better. The almost total lack of QRM on 2m FM stands out as a shining beacon to the beleagured low banders.

The arrogant and the childish will always have their problems — with their own repeaters — with the press, and I don't know of any way for these difficulties to be resolved since psychotherapy seems the only out and it isn't going to be used. No, I think that there will always be some areas of controversy. It is up to the readers to decide which sides of the controversy are most in need of electric shock treatment. On this point, the switch to solid state leaves some doubts since twelve volts will never impress anyone like 2000 volts will. Looking on the bright side — all those old Gil cartoons on Switch To Safety can at last be put in the ARRL museum.

In the long run we are all headed for a listing in QST under Silent Keys. In my mind, the measure of an amateur is how much fun he was able to bring to others. 1200 watts output on 79 brings fun only to the chap with the fiendish gleam in his eye as he watches his output meter. The alligator he creates brings un-fun to everyone else. Badmouthing over the air may gratify the chap who is doing it, but it is unpleasant for most listeners.

I'm the proud possessor of a used (new to me) Hallicrafters SR-42A. I'd love to FM the thing, and I'm really curious about any other things I could do to it to make it even better.

I'd appreciate any help you could give me on this. Might be a problem getting enough deviation, since the vfo is in the 20 MHz area, as are the crystals for the thing.

Many thanks for any help you can give me. And keep up the fine work in 73 — it's the one ham magazine that makes the hobby fun, as opposed to an oldtimer's "remember when...." journal.

George Lesch WB2ENP
Staten Island NY

Can anyone bail old George out?

I am curious to know what the message from Wayne (BIMEK FUSAJ CAQOF) on the "contents" page of the September '72 issue. Would appreciate any light you might shed on this matter.

Reggie W5SSB

Naval crypto prefix to indicate cypher being used.

Please enter my name for a one year subscription to 73. I've been buying it on the newsstand for about a year and it has definitely been the best magazine I never subscribed to.

I hope you don't mind my not sending the coupon which forms such an integral part of your last issue. I detest cutting up magazines for the purpose of removing coupons almost as much as I detest others cutting up my magazines for the purpose of removing coupons. There almost always is a good article worthy of saving on the reverse. And when there is not, there is an advertisement which I want to keep for reference. Is there a publishers' conspiracy against those who want to keep their magazine collection intact?

Bill Garfield's "Poor Man's Transcanner" in the August issue brought to mind a letter from Regency which I got from a friend about two years ago. It provides some conversion infor-

CONTINUED

mation not provided by Bill. Whether or not the changes will improve the sensitivity I cannot say. The earlier units may have had trouble tuning down to the 2m band and the current ones may do so with no difficulty at all. No matter what the case, your readers may appreciate having the supplemental details. I doubt if Regency would have any objections to your quoting the letter, especially since it can do nothing but help their sales.

Robert E. Tashjian
Canoga Park CA

Here are the details from the Regency letter:

Subject: TMR-H Series
in Two Meter Band

1. Modifications that are necessary to move this unit into 146–148 MHz portion of the 2 meter amateur band.
A. Replace three capacitors and retune the RF section.
C201 replaced with a 12 pf.
C203 & C206 replaced with 6.8 pf.
Retune L201, L202 & L203
Note: The ceramic filter presently being used is only proper for NBFM (5 KC deviation). If wide band FM is employed, the filter would have to be replaced (CF455-AP should be adequate). The quadrature coil may have to be swamped more than it is now.
B. You can expect 0.7 or better, microvolt sensitivity for 20 DB of quieting.
C. By adding one wire, terminals 3 and 4 can be utilized for *muting* purposes, connect terminal 3 to the junction of the blue wire and R310 (33k) on the scanner board. If terminal 3 is then externally switched to terminal 4 during transmission, the receiver is effectively muted or disabled.
D. Two germanium diodes, back-to-back, soldered across the receiver's input, will provide sufficient RF transistor protection.

Each time details of an airline hijacking appear in a newspaper, probably three more are committed. And, at least two guys have been killed in an Italian restaurant since "The Godfather" came out. But never before have I seen published step-by-step instructions for killing hams.

The "Cigar Tube" article on page 28 in the September 1972 issue, suggests forming a ground connection through your body by holding the chassis with one hand and the damn tube with the other hand.

Well, even if the .1 Cap isn't shorted and the thing isn't built wrong, at any frequency over a few cycles, that .1 Mfd impedance starts looking mighty small in comparison with your body resistance. Just try accidentally probing an RF output or the output of your hi-fi set, using your arms as a ground return. Pffft!

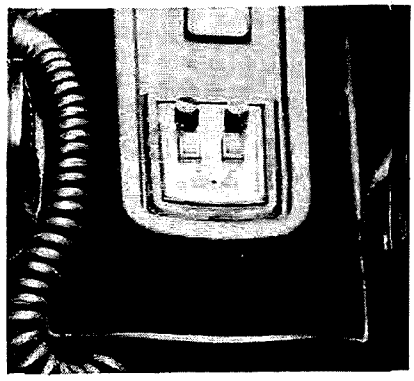
Please edit these articles more carefully and print some sort of retraction to the paragraph in question in the next possible issue. How about a signal injector that will only work with one arm behind your back?

Gary Budiansky WA1MCR
Acton MA

Sorry, but something strange comes over us every time we publish a "tube" article.

I noted with interest the picture and article on page 50 of July 73. I had the same problem with a 1969 Fiat 124 coupe. I use a Motorola D-43 trunk-mount and had the control head between the driver's seat and the console. When I bought a new Fiat 124 Spyder, I decided to do it right.

As you can see from the enclosed photo, the control head is built into the rear ashtray of the console. The purpose was twofold: to make the existence of the rig a secret (I park in downtown Boston daily) and to preserve the interior "esthetic beauty" of the 124 Spyder.



The cable seen at the bottom of the enlargement runs to the D-43 in the trunk. The microphone cable can also be seen going under the console into the control head. By running all cables under and inside the console, I have been able to avoid drilling holes in it. A twisted pair runs from the control head to the BC receiver's speaker. Another pair run forward to the engine compartment to activate the 12VDC 80Amp relay which turns everything on and off. The controls are pretty straightforward: volume, squelch, green light power on, red light for transmit, on-off switch and frequency select switch. The antenna incidentally is a Larsen 5/8 wave mounted on the trunk.

Barry W. Fox K3IWW/1
Ayer MA

On a rainy afternoon last June, I had the pleasure to visit you and the staff of 73. I wish to extend my sincere appreciation for your time and personal interest extended to a fellow amateur by yourself and staff.

Although the state of Mississippi may be remote on your itinerary, I would like to extend to you the warm hospitality I received in New England, should you chance this way.

As I mentioned to you, Wayne, I have followed your articles over the years through thick and thin with avid interest.

Laurence P. Williams W5IIQ
Ocean Springs MS

Our pleasure!

From time to time you mention foreign hams having trouble getting electronic equipment because of lack of funds or import problems.

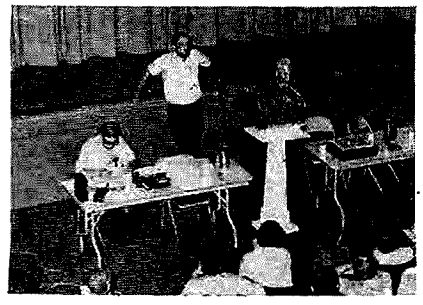
I have a General Electronics, Inc., multiphase Exciter MOD 20A with a BC 458 modified for use as a VFO including instruction manual for the 20A. I would be pleased to donate this equipment and pay postage if you can suggest anyone needing it.

David D. Blackmer WA6UNK
Rt. 1, Willow Road
Nipomo CA 93444

Suggest you write to B.A.N. Raju, Radio Constr. & Development Unit, Civil Aviation Department, Safdarjung, New Delhi, India for name and data on getting rig to them through customs. If anyone knows amateurs in any countries who would appreciate and use some older gear please let 73 know – and if you have gear, why let it sit in the closet – why not get it into needy hands?

73 is by far the best. I let my QST subscription run out so I could subscribe to 73 for two years instead of just one.

J E. Babeckis WB9GXB
Chicago ILL



Here is a photo of the Baldwin Park frequency coordination meeting held on 9 September '72. I hope it can be of some use to you. John Griggs W6KW is at the mike and Skip Clark WB6TXX is leaning against the stage.

Thank you for your motivation of the people here on the west coast. I feel that it was you who got us moving, and temporarily out of the grips of the FCC.

Dan Halpert WA6JQR
Malibu CA

Dan Halpert WA6JQR
Malibu CA

continued on page 318

AMATEUR RADIO AND EDUCATION IN YUGOSLAVIA

A. Stipanic YU3BH
Secretary SRJ

The Union of Radio-Amateurs of Yugoslavia (Savez radioamatera Yugoslavije – SRJ) is one of the youngest national organizations of radio amateurs in Europe. In 1971 it will celebrate the twenty-fifth anniversary of its foundation. Today, SRJ has in its ranks about 42,000 members, and among these are some 10,000 licensed radio operators. It is evident that the technical education of such a large number of members and radio operators in a relatively short period of time has required considerable efforts on the part of that organization, and special working methods, which may be summarized as follows:

The basic organizational unit of the SRJ is the radio club. At present there are 415 radio clubs and 348 branch clubs in Yugoslavia. These are organized within the radio amateur unions of 6 Federal Republics and 2 provinces. These various unions are then grouped together into one national organization – the SRJ.

Following this organizational scheme, the SRJ represents radio amateurs of Yugoslavia at a federal level, uniting them and establishing a policy of developing amateur radio throughout the country as a whole.

All the radio clubs, the unions of radio amateurs of the federal republics and provinces and the SRJ itself, are headed by committes which are elected every two or three years by the members of the organization they represent, or by assemblies in which every member can participate. There are no representatives of local, republic or federal state authorities in these committees.

Every licensed radio amateur in Yugoslavia must be a member of a Yugoslav radio club. This is provided for by law, and hence the SRJ is in a position to unify the educational policy of radio amateurs throughout the country.

The basic methods of education are evening courses in electronics, radio techniques, Morse code, etc., which are usually organized by the radio clubs or their branches, and sometimes also by public schools, universities, factories, or other appropriate institutions in which sufficient candidates can be found to justify the preparation of such a course.

The SRJ has established a special plan for these courses, laying down a certain minimum knowledge required to become a radio operator within a club or private amateur radio station.

Under Yugoslav law, the SRJ has the right and duty to form examination boards, the members of which are experienced Class I or II operators. No representatives of the state authorities sit on these boards, and the operators one can hear every day, under YU or YT call-signs, are the exclusive products of the education acquired in radio clubs by the members of the SRJ.

In addition to this, we also have special seminaries and courses for so-called constructors, to qualify them as lecturers at evening courses in radio clubs. These seminaries, lasting from 10 to 20 days, and courses for lecturers, are usually organized in summer camps by the unions of radio amateurs of the federal republics and provinces, during the vacation period. In addition to theoretical lectures, participants quite often build a practical instrument, such as a converter, antenna, etc., which they use in their own radio clubs to improve the equipment they already possess. Sometimes seminaries are also held for the special branches of amateur radio. To cite a few examples only: fox hunting, VHF and UHF work by meteor scatter, moonbounce, and so on.

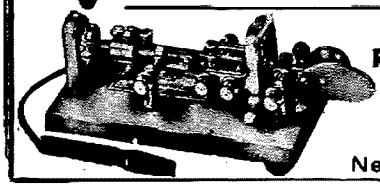
I must stress that all the work of lecturers at evening courses, seminaries or other forms of education of radio amateurs in Yugoslavia, is on a strictly voluntary basis.

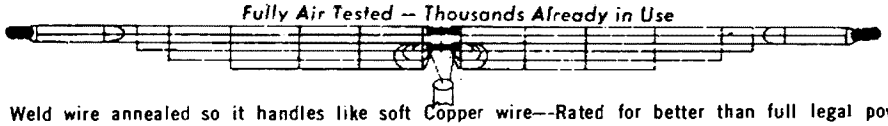
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ment thoroughly and to learn how to work efficiently in the field of amateur radio, special care is dedicated to educating future radio amateurs in "ham spirit," to ensure that they will ultimately become true ambassadors for peace amongst all the nations of the world.

That is one of the reasons that we have on our programme of examinations several questions concerning the international amateur radio movement, its organization, etc.

That is, briefly, what I wished to say about the education of radio amateurs in Yugoslavia. It is understandable that all this work also represents a noteworthy contribution by radio amateurs in aiding the education of youth. This is, in fact, one way – and a fine way – of raising the general technical and humanitarian level of young people.

I must here also underline that many elementary schools, as well as some high schools, have assimilated certain parts of the educational programme of the SRJ into their own technical education programmes. The practical consequence of this procedure is that the SRJ has its radio clubs in all universities in Yugoslavia and in many high schools. Several hundred teachers and professors are radio amateurs, and it is obvious that they seize every opportunity to influence their students to enter amateur radio.

SRJ has organized a special activity, called "Spring on the Radio Waves," when groups of radio amateurs with their stations visit public schools to transmit their prepared programmes to other schools in the country. There is no doubt that this also offers another real opportunity to inspire young people to join amateur radio.

Furthermore, television, radio, newspapers and various magazines often broadcast or publish articles on amateur radio. This is especially the case when radio amateurs have shown their ability to help at times of national disaster. You will all remember the earthquakes in Skopje, and Banja Luka and the floods in Zagreb, where radio amateurs were the only ones able to link up the stricken areas with the rest of the world. . . .YU3BH

K. Slomceynski SP5HS
Secretary PZK

THE EDUCATION OF RADIO AMATEURS IN POLAND

The Polish Amateur Radio Society (Polski Zwiazek Krotkofalowcow – PZK) is continuing its training programme in close cooperation with the Polish PTT Administration. This cooperation is based on the well-known fact that the field of amateur radio is one of the best training schools for highly qualified radio and telecommunication specialists. And what is also important – this specialized training is provided by the amateurs themselves, without any expensive buildings, equipment or teachers.

The PZK also carries out its amateur educational programme in cooperation and alliance with two other youth organizations in Poland: the Polish Boy-Scouts (ZHP) and the League of Home Defence (LOK). The first of these unites hundreds of thousands of schoolboys and girls; the second has multiple activities, such as motoring, competition shooting, the building of ship or aircraft models, telephone and radio training, etc. Each has its own radio clubs, operating amateur radio stations.

The educational programme of the PZK is orientated in the following three directions:

1. The propagation of the basic principles of amateur radio among a wide public, especially among boy scouts, and schoolchildren.
2. The technical and general education of newcomers, both short-wave listeners and novices;
3. The specialized training of experienced amateurs, helping them to be "au courant" with the latest state of the art in telecommunications.

The first line of action is administered by the Public Relations Commission of the PZK HQ Council, directed by Vice-President SP5JE who is Director of the Technical Department in the Polish PTT Ministry. The commonly used methods are: amateur programmes in broadcasting and television, articles concerning amateur radio in newspapers and popular magazines, and PZK's own publications and leaflets, such as: *"How to become a Radio Amateur," "Amateur Radio"* (intended for boy scouts), etc.

At the end of 1970 the second TV programme came into operation in Poland and the PZK has commenced weekly amateur lectures at a popular level. In addition, the weekly bulletins, dedicated not only to amateurs, are transmitted on 80 and 40 meters by our HQ station, SP5PZK.

The most important activity in the second direction is aimed at converting the young newcomer, who is just starting to listen in on the amateur bands, into an experienced amateur operator ready to construct a complete do-it-yourself station and to operate it under various conditions. This part of our programme is supervised by the HQ Commission for Amateur Education, and managed by PZK Vice-President SP5JH (who is also Chief of Communications in the Boy-Scouts' Headquarters).

The newcomer's training programme is based on the fact that our Society is responsible not only for strictly technical education, but also helps schools and parents in the general education of young people.

The training programmes of the PZK are officially accepted by the PTT Ministry and are coordinated with the official requirements for amateur examinations.

. . .SP5HS

Herbert Götze, DM2HGO
(President of the Radio Club of the D.D.R.)

AMATEUR RADIO TRAINING IN THE GERMAN DEMOCRATIC REPUBLIC

The training activities of the German Democratic Republic Radio Club are based on the amateur radio regulations first issued by our national telecommunication authority, the "Ministry for Post and Telecommunications." The present version came into force in 1965. We consider that these regulations, which were worked out in cooperation with experienced radio amateurs, are very liberal and progressive. Our view has been confirmed by many OM's from other countries.

As from the age of 14, every citizen may become a radio amateur – i.e., may be granted a radio amateur license. In some cases, this is even possible at an earlier age.

Finally, the fourth permit is assigned to radio amateurs who only wish to use radioteleprinting (RTTY). No telegraphy ability is required here either, merely the proof of competence in the operation of a teleprinter.

I have begun this explanation about our amateur radio regulations because from these arise the demands for the training of radio amateurs. In conformity with the subject of the examinations comprised within these Regulations, the Radio Club of the G.D.R. has worked out a comprehensive and unitary programme of training, which reflects every aspect of radio amateur activity, both theoretical and practical. Training schedules are developed in the clubs, based on this programme, which include a thematic and time arrangement.

When selecting the literature, we restricted ourselves to a few publications available everywhere in the Republic, so as to maintain unity with the standard of training. Moreoever, extensive documentation exists concerning amateur radio in the G.D.R., Foreigners who have been resident in the Republic for a long period, such as students at our universities or high schools, or mechanics and businessmen in foreign firms, can also get an amateur radio license, free of charge and without membership of our Club being obligatory. To complete the picture, I would just mention that foreigners who are the guests of our Republic and who already hold an amateur radio license in their home country, are also granted a guest's license.

Our amateur-radio Regulations provide for four classes of permit: Class "2" is provided for newcomers and requires an ability of only 40 letters per minute CW and a relatively simple knowledge of radio technology. This license therefore only entitles the holder to work on 80 and 20 meters, with a maximum antenna input of 20 Watts.

The holder who has worked under such conditions for one year may apply for another class of permit, namely, the main class "1." This entitles the holder to work on all bands, in any mode and with a maximum input of 300 Watts.

Another type of permit, considered as a technical license, is for VHF amateurs. CW ability is not required for this class.

some of which is also internationally known, such as *"The Antenna Book"* by Rothammel (DM2ABK) and *"Amateur Radio Practice,"* by the same author, to cite only two examples.

In the booklet series *"The Practical Radio-Amateur,"* of which more than 90 numbers have been issued until now, nearly all the desires and interests of radio amateurs are taken into consideration.

For three years a new book series, *"The Amateur Library"* has been published. In this series, five special works for radio amateurs and amateur electronicians have so far been published. Besides this, the Radio Club of the G.D.R. issues special instructions for amateur construction activities, in which especially approved standard equipment is described in detail. The training programme and the relevant literature for teaching and private study both provide a good basis for an effective amateur radio training.

Training is carried out in our club stations, of which more than 600 exist at present in the Republic. They are to be found within youth-clubs, clubs of various industries and business firms and within the precincts of our own club.

In principle, the future radio amateur, in his training, passes the qualification stage as a receiving amateur. Prior to this, he has already had the opportunity of acquiring a diploma of the Radio Club of the G.D.R., the so-called HADM-Diploma (Heard All DM), by fulfilling simple tasks as a broadcast listener.

Within the qualification stage, as a listening amateur, he may at first be active as a receiving amateur candidate. He is given a listener's number and may benefit from all the facilities offered by the Radio Club to amateurs. The examination, which does not require any knowledge of telegraphy, is passed in a club station before an examining committee, consisting of licensed radio amateurs.

Thereafter, he receives from the radio club a listener's diploma, which entitles him to work as a receiving candidate for two years. Within this period, he may further qualify as a receiving amateur; depending on his inclination, he may qualify for listening activity in all radio amateur bands, including the 2m and 70 cm bands, whether he has knowledge of telegraphy or not.

The club stations are equipped with the financial aid of our union and by that of industries and other institutions.

The sound policy of school education in our state, which, among others, is also reflected by polytechnical training, is a good basis for our young citizens to understand the phenomena of natural science and consequently the secrets of electrotechnics and radio engineering.

A great number of our listeners are young people, which does not mean that there is any limitation to age, for we had the case in Berlin where a 65-year-old engineer qualified as a radio amateur!

In the field of the listener's movement, we have created a possibility for receiving amateurs, having reached corresponding results, to acquire a permanent "master" title or, by means of a competition of limited duration, the title of a so-called "master of the year."

The activities of our radio amateurs are guided, on the part of the radio club, by a special section devoted to youth work and listener's affairs, which is directed by prominent pedagogues, themselves radio amateurs. Needless to say, this technical training goes hand-in-hand with general education and training in citizenship.

In his further advanced training, the receiving amateur qualifies, in the club station or in central courses of the radio club, as a transmitting amateur. Our regulations lay down that, at first, he should cooperate for some time as a radio amateur in one of our club stations, in order to extend his experience and knowledge under the direction of experienced amateurs.

In accordance with these regulations, he can work either as a short-wave or as a VHF amateur. The latter is a type of authorization which, at international level, is known as a Technician's License, for which no telegraph knowledge is required and which is acquired by a great number of experts from the electronic and radio-engineering world, particularly as, in the examination, chief stress is laid on technical matters, in addition

to comprehensive knowledge of the relevant regulations.

Radio amateurs who are knowledgeable and who assist our union in the fulfillment of its duties, have the opportunity of receiving the authorization to operate a private station. This is considered a distinction for good work.

Great value is set on the continuous advanced training of our radio amateurs and neither effort nor money is stinted to this end. By means of our radio amateur technical journal "Funkamateur" and other special series, some of which are licensed eiditions which are also known in other countries, the amateur has the opportunity of qualifying by private study. These series are also available to beginners and are widely read and studied by others interested in technical matters. In addition, meetings of radio amateurs which are organized in club stations, or at district or republic level, offer excellent chances of advanced training in all fields.

We plan to increase the stimulus for continuous perfectioning, by creating an amateur radio master title or qualification degree that can be acquired by the radio-transmitting amateur.

It is taken for granted that participation of our amateurs in competitions organized by our own and foreign unions is also considered an excellent opportunity for advanced training, and both radio receiving and transmitting amateurs make wide use of this means.

Cooperation in the field of national and international amateur radio observation, for which our union issues relevant instructions jointly with competent scientific institutions, is also included in training and advanced training.

We maintain a constant exchange of experience with the unions of socialist countries and would be very glad to enter into an exchange of ideas with other unions too. Unfortunately, it would appear at present that close contacts rarely exist at an official union level, and it is our hope to be able to change this situation by future membership of the I.A.R.U.

. . .DM2HGO

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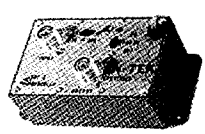
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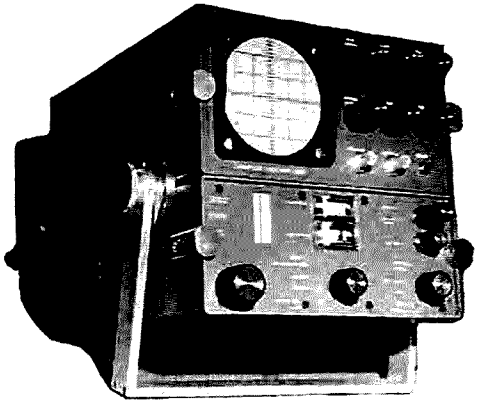
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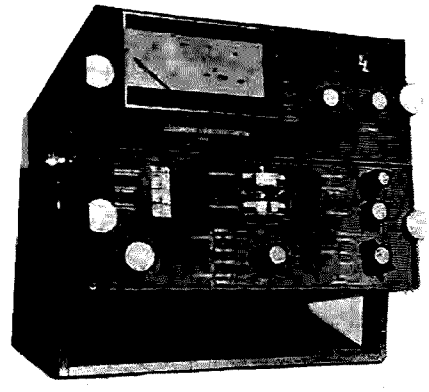
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Another less cumbersome route is to carefully unsolder the spider and slip a scrap of fishpaper or similar insulation into the void. The same must be done to other legs of the spider even if they are not soldered. Both the rotor and stator are now above ground and may be connected as desired.

. . .WAØABI

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A PROFESSIONAL DIGITAL COUNTER

Quite a few articles have appeared in the literaure of the past months, describing digital counters as a brilliant addition to the experimenter's arsenal. Some of these almost stimulated me to action, but there always seemed to be a vital objection to each of them somewhere along the line. A number of these designs required neon bulbs or nixie tubes with the necessary 200V power supply and high-voltage transistors. Some of the logic circuits seemed cumbersome, some of the articles seemed simple enough but were so sketchy that the builder was almost left to start from scratch when confronted with the actual layout and circuit design.

A recent development made it possible to eliminate all these objections and started a labor of love which will be described here. Tung-Sol recently announced a new readout device which is actually a tiny cathode-ray tube. Two tiny filament wires (requiring only 1.6V at 45 mA) supply electrons to bombard a seven-segment digital-8 (See Fig. 1), each of these seven segments being a separate phosphor anode which requires from 12 to 25V at only a few mA. This miniscule power requirement and compact readout tube makes a really small and inexpensive counter possible. It is called the Digivac S/G, and is relatively cheap in small quantities, at $5.30 each. Texas Instruments makes an integrated circuit which takes BCD information from a set of flip-flops, resolves it into seven-segment logic, and drives the Digivac tubes directly with the proper voltages. Another company, General Instrument Corp., even includes the decade counter and driver circuitry in a single IC package. This makes a really tiny counter possible, but at a pretty stiff price for the average ham. This article describes a compromise approach which utilizes the advantages of the Digivac tube to build a compact counter with simple power-supply requirements, but at a rock-bottom cost.

I believe that this layout is the ultimate in tiny counters, when cost is considered. The low voltage requirements of the Digivac tube make it possible to use any old transistors that will block 22V (I took mine off old surplus computer boards) and the least expensive of RTL IC's easily furnish enough drive for our purposes, and will count at better than 10 MHz. The complete 6-digit counter was built on a 4½ x 5½ in. etched board. The board is etched both sides

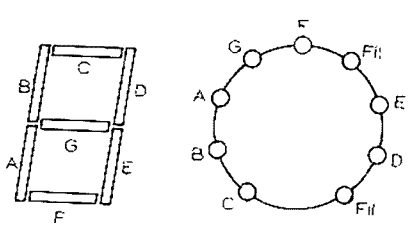


Fig. 1. Anode layout and base diagram of the Digivac S/G readout tube.

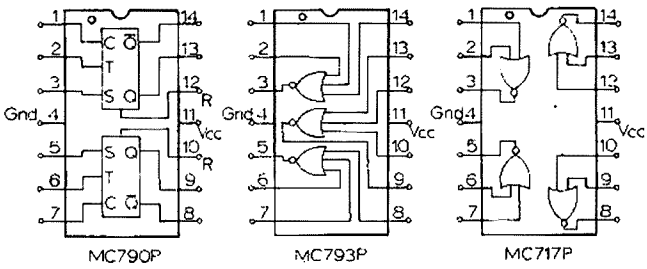


Fig. 2. Basing diagrams of the integrated circuits, as seen from the top of the package.

because of the complexity of the circuit, the clearances for the components are pretty close, and the soldering must be precise to avoid solder bridges to other conductors, but this should not be a real problem with proper equipment. I used a Princess soldering pencil with a 10W element and the finest pointed tip I could find. With this, I soldered all the transistors, diodes, and IC's, both above and below the board, without a heat sink, and didn't ruin a single one.

The logic could be made slightly more simple using *nand* gates or various combinations of *nand* and *nor* gates, but at considerable greater expense. Not counting the transistors and diodes, which I took off old computer boards, the counter cost about $13.00 per digit to build. As each consecutive pair of digits shares one of the IC's, the counter can be built in multiples of two digits – if you only require four digits for the readout on your vfo, you can just lop the board off at that point.

The Digital Logic

The devices used for the actual counting are Motorola MC790P's which contain two J-K flip-flops in one package (Fig. 2). Rather than simply dividing by two, J-K flip-flops make other options possible. Each of these flip-flops has two output pins, each of which can have two states – "high," which is a little over +1V, and "low," which is just a

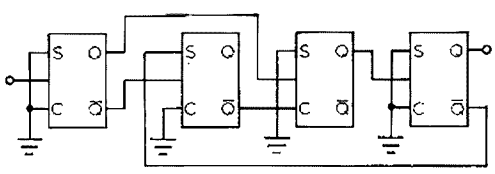


Fig. 3. Connection scheme for the Modulo-ten minimum-hardware circuit.

Table 1
Truth tables for the *nor* gates and J-K flip-flops.

Nor Gate			J-K Flip-Flop		
Input A	Input B	Out	S	C	Q
Lo	Lo	Hi	Hi	Lo	Hi
Hi	Lo	Lo	Lo	Hi	Lo
Lo	Hi	Lo	Lo	Lo	Reverse
Hi	Hi	Lo	Hi	Hi	No Change

tenth of a volt or so above ground. These two output pins are called "Q" and "$\overline{Q}$," and they are always complementary to each other – when "Q" is high, "$\overline{Q}$" is always low and vice versa. There are four inputs: a reset pin, which brings "Q" to the low state, 'Set," "Clear," and "Toggle." The flip-flop changes state only following a *fast* negative-going pulse on the "Toggle" pin. Which state is entered after a "toggle" pulse depends on the voltages on Set and Clear. (See Table 1.) If more information on this subject is required, see References.

Four flip-flops can most easily be made to count to 16, but for our purposes, we want these to count to only 10. The arrangement used here is called the Modulo -ten minimum-hardware circuit, and is commonly used to divide by ten (Fig. 3), but more complex arrangements are usually used in counters for decimal readouts such as nixie tubes. The states of the outputs through a count of ten are found in Table 2.

In this case, the Modulo-ten was the simplest arrangement I could find from a logic standpoint, because I wanted to energize a 7-segment readout. It was also noted that a matrix which switches off the segments, is a lot simpler than one which switches them on. So that is what this circuit does. All of the segments of the tube are "turned on" except when +0.7V or so is

Table 2
"Q" output states in a Modulo-ten circuit, through a count of ten.

	Q1	Q2	Q3	Q4
0	0	0	0	0
1	1	1	0	0
2	0	1	1	0
3	1	1	1	0
4	0	1	0	1
5	1	0	0	1
6	0	0	0	1
7	1	1	0	1
8	0	1	1	1
9	1	0	1	1

present at the base of the shunt resistor for that particular segment, which then effectively grounds that segment. The complete logic diagram for each digit is found in Fig. 4.

The gates used are *nor* gates; the output of these gates will always be *low* except when *all* inputs are low; then it will be *high* (Table 1). There are also three diode gates used, which simplifies the circuit (this translates "cheaper") considerably. The 2700Ω resistor at the output of one of the gates, slightly increases the voltage output, which otherwise did not reliably energize the "B" and 'G" transistors, because of the additional voltage drop through the series diodes. These are used on the underside of the board, 1/10th watt resistors are a convenient size here. (For placement, see photograph.) You may know that the MC792P has a higher output, voltage-wise, but do not use it! The MC792P would also load the flip-flops much too heavily for this application.

Construction

The circuit board is etched on both sides, and care is indicated to assure that the two

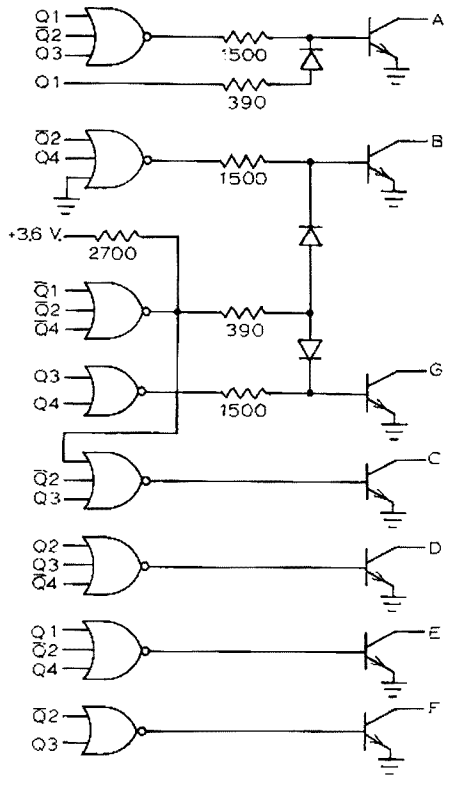


Fig. 4. Logic diagram for each digit. Each of the transistors will ground one anode segment when turned on.

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S	M	T	W	T	F	S
			1	(2)	3	4
5	6	[7]	(8)	[9]	10	11
12	13	[14]	(15)	[16]	[17]	(18)
[19]	[20]	21	22	23	24	25
[26]	(27)	(28)	(29)	[30]		

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3A	3A	7	3A	7	7A	14	21	14
ARGENTINA	14	7	7	7	7	7	14A	21	21	21	21	21
AUSTRALIA	14	7A	7B	7B	7B	7B	7B	14	14	14	14A	21
CANAL ZONE	14	7	7	7	7	7	14	21A	21A	21	21	21
ENGLAND	7	7	7	3A	7	7B	14	21	21	14	7B	7
HAWAII	14	7A	7	7	7	7	7	7B	14	21	21	21
INDIA	7	7	7B	7B	7B	7B	14	14	7A	7B	7B	7
JAPAN	14	7B	7B	7B	7	7	7	7	7B	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14A	21	21	21	21
PHILIPPINES	14	7B	7B	7B	7B	7	7	7	7	7B	7B	7A
PUERTO RICO	7	7	7	7	7	7	14	21	21	21	14A	14
SOUTH AFRICA	7B	7	7	7	7B	14	21	21A	21A	21A	21	14
U. S. S. R.	7	7	3A	3A	7	7B	14	14A	14	7B	7	7
WEST COAST	14	7A	7	7	7	7	7	14	21	21	21	21

CENTRAL UNITED STATES TO:

ALASKA	14	14	7	3A	3A	7	3A	7	7A	14	21	21
ARGENTINA	14	14	7	7	7	7	14	21	21	21	21	21
AUSTRALIA	21	14	7B	7B	7B	7B	7	7	14	14	14A	21
CANAL ZONE	14	7A	7	7	7	7	7A	21	21A	21A	21A	21
ENGLAND	7	7	7	3A	7	7	7B	14	21	14	7B	7
HAWAII	21	14	7	7	7	7	7	7	14	21	21	21A
INDIA	7	7	7B	7B	7B	7B	3B	7A	7A	7B	7B	7
JAPAN	14A	14	7B	7B	7	7	3A	7	7	7B	7B	14A
MEXICO	14	7	7	7	7	3A	3A	14	21	14A	14A	14
PHILIPPINES	14	14	7B	3B	7B	7	3A	7	7	7B	7B	14
PUERTO RICO	14	7	7	7	7	7	14	21	21	21	21	21
SOUTH AFRICA	14B	7	7	7	7B	7B	14	21	21A	21	21	14
U. S. S. R.	7	7	3A	3A	7	7B	7B	14	14	7B	7B	7

WESTERN UNITED STATES TO:

ALASKA	14A	14	7	3A	3A	7	3A	3A	7	14	21	21
ARGENTINA	21	14	7	7	7	7	7	14	21	21	21	21
AUSTRALIA	21	21	14	7B	7	7	7	7	14	14	14A	21
CANAL ZONE	14A	14	7	7	7	7	7	14	21A	21A	21A	21
ENGLAND	7	7	7	3A	7	7	3B	7B	14	14	7B	7B
HAWAII	21A	21	14	7	7	7	7	7	14	21	21	21A
INDIA	7B	14	7B	3B	3B	7B	3B	3A	7	7	7B	7B
JAPAN	21	14	7B	7B	7	7	7	3A	7	7	7A	21
MEXICO	14A	14	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	7A	7B	7B	7	7	3A	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7	14	21	21A	21	21
SOUTH AFRICA	14B	7	7	7	7B	7B	7B	14	21	21	21	14A
U. S. S. R.	7	7	7	3A	3A	7	3A	7A	7A	7B	7B	7B
EAST COAST	14	7A	7	7	7	7	7	14	21	21	21	21

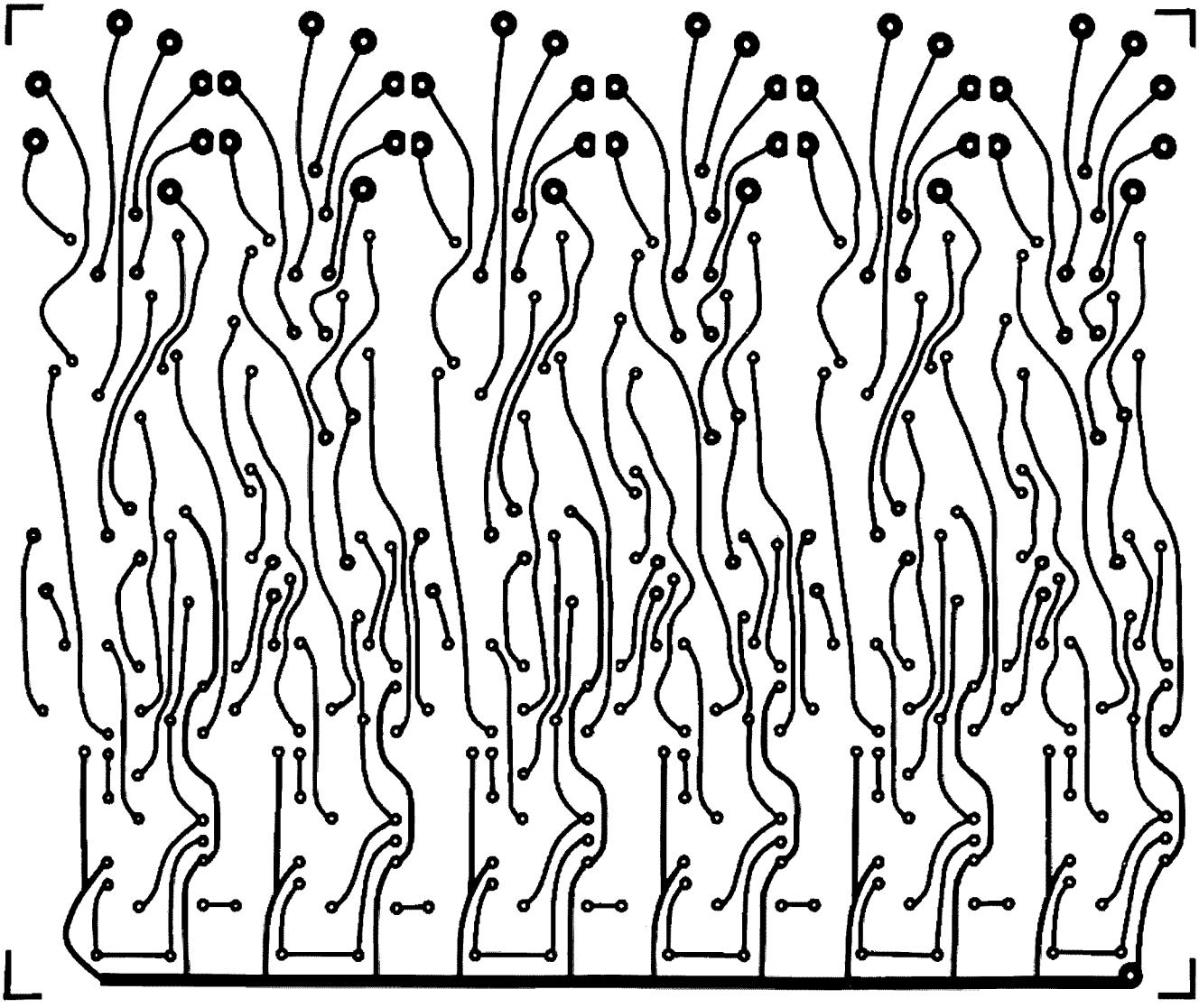


Fig. 5. Component side of the circuit board, full-size.

sides are properly matched. I built a jig for this purpose out of 2 7 x 7 in. pieces of 1/8 in. Lucite. All four corners of the Lucite are drilled with the two sheets clamped together. Tape the two negatives to the adjacent sides of the Lucite so that the negatives match properly with the two sheets of Lucite bolted together. Then the sensitized board can be clamped between the two negatives and exposed with assurance that the holes will match up once the board is etched.

It is also possible to etch the board one side at a time. For this method, only one side is etched at first with the other side protected from the etching solution. Then several pilot holes are drilled in the edges of the board. The second negative is then placed on the other side of the board and made to line up with the pilot holes for the second exposure. This method would probably be satisfactory only when you are equipped to use spray photo-resist. However, a pre-sensitized board, coated on both sides, would be very hard to expose, etch, and drill without damaging the sensitive emulsion on the second side of the board. It can be done very easily if you are properly equipped, but be sure to cut the burrs from drilling off the second side of the board before coating and etching, as the burrs pick up an extra collar of resist which gets in the way, and they also tend to scratch up the negative.

Once the board is etched, the holes are drilled. It is probably possible to this with with a ¼ in. electric drill, with extreme care, but a drill press is strongly recommended if you can possibly get access to one. I used a No. 72 drill for the integrated circuits, transistors, and diodes, a No. 60 drill for the resistors, and a 1/16 in. drill for the tube sockets. If you are using fiber glass board, be

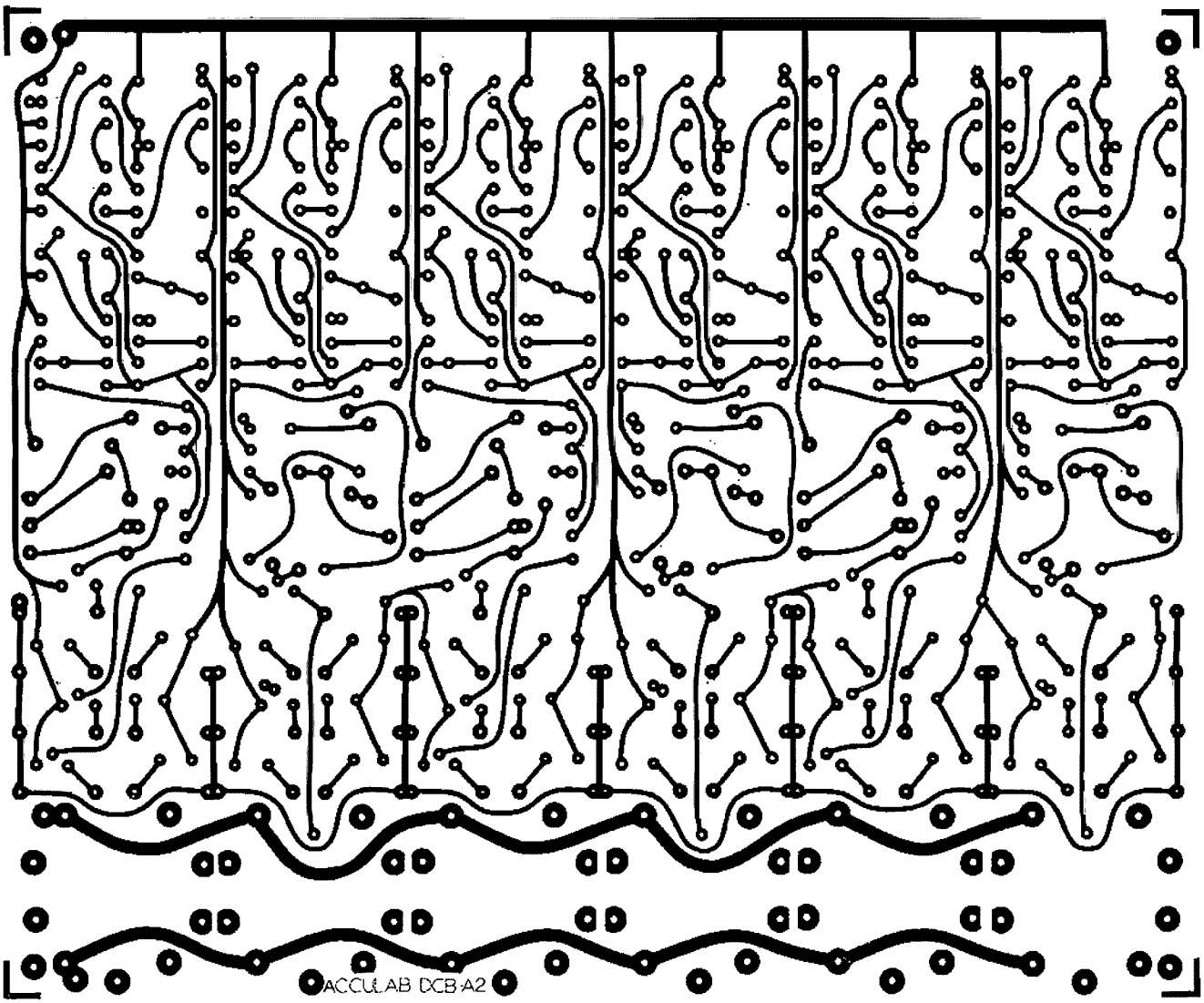


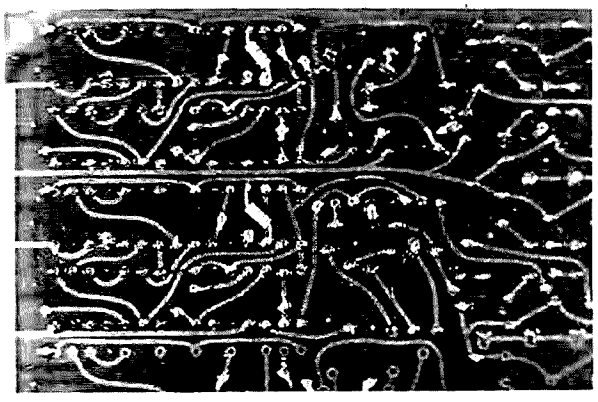
Fig. 6. Second side of circuit board, full-size.

sure the drills are sharp, because I found that a drill which is dull creates much heat which swells the fiber glass, and this can pop the foil terminals right off the board. Fiber glass also dulls the drill bits much more quickly, too, and there are something over 840 holes to be drilled in this board! The drill sizes specified are not sacred, but anything much bigger may just drill the terminals right out of existence, as they are necessarily small.

Once the board is etched and drilled, the next step is to install the jumper wires. Most of these are for power supply or ground connections, or for reset lines to the flip-flops. There are also a number of through-wires to bring current through the board from one side to the other. I used 22-gage wire for this.

Now you can begin installing the actual components. Note that the component side of the board contains the conductors to most of the tube pins. The other side carries the label. It is wise to install one tube socket, then a pair of load resistors (10K) next to the socket, then the first pair of transistors. Note that some of the connections must be soldered on *both* sides of the board.

Once the first two transistors are installed, it is wise to put +18V between the B+ terminal and ground, to be sure that these transistors will hold this voltage satisfactorily without breaking down. Then put the same voltage, through a 22K resistor, or so, between the bases of the transistors and ground, while measuring the collector voltage, to be sure that it will ground the anode of the tube properly. It is best to test these in pairs as you install them, as it is a lot more trouble to get to them once some of the others are in place. Once you are sure that a pair of transistors works, then go on



Arrangement of 1/10th watt, 2700Ω resistors under the board

to the next pair of load resistors and then the next pair of transistors. Then be sure to check all of the solder joints and be sure you haven't miss d one or more on the component side, and be sure there are no solder bridges, which will be harder to eliminate later on.

After the transistors, the next step must be installation of the first IC, the MC717P. It is very wise to first tin the foil terminals for the IC's, at least on the component side of the board, as there is no way to heat-sink these soldering operations, and this greatly reduces the amount of heat exposure to the IC. It will be almost impossible to get to some of these joints above the board, once the resistors and diodes are in place. Note that the MC717P's are the only IC's which have the notch and dimple on the package, positioned *away* from the tube sockets – all the others have the notch and dimple on the end *toward* the tube sockets.

Next the diodes can be installed. The cathode ends of the diodes, usually marked with colored bands, are always on the side toward the conductor leading to the bases of the transistors. On the digits where the diodes are horizontally arranged, this is the end *toward* the tube sockets. On the digits where the diodes are vertically arranged, this is the end *toward* the MC717P, except the center diode is reversed.

Now the other resistors can be installed. Note that two of these are 390Ω resistors, these lead from outputs Q1 and Gate 7. The rest are 1500Ω.

Following this, install the two MC793P's and two MC790P's. Be sure the notch and dimple on the cases are on the end *toward* the tube sockets. Be sure to tin the foil terminals on the component side, for these IC's, also, to mimimize the heat loads they have to take in soldering.

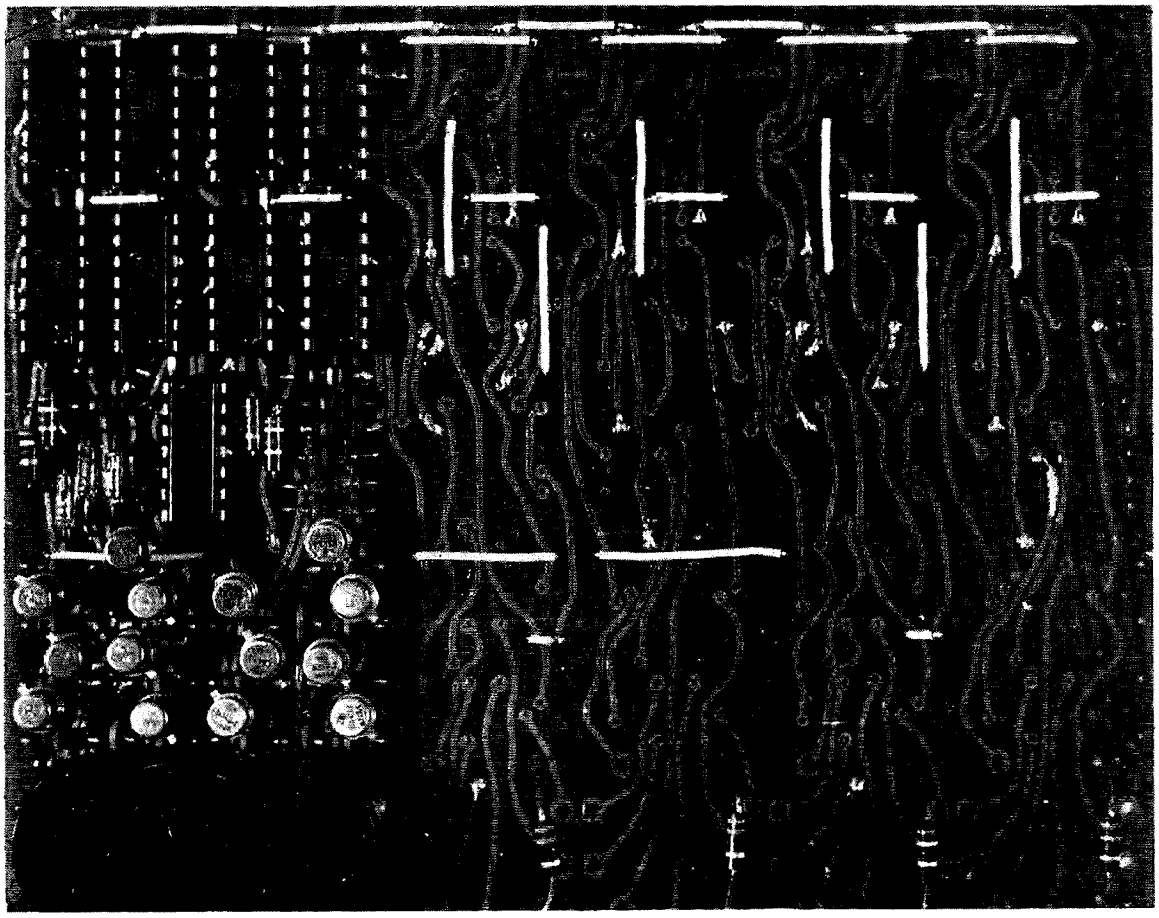
Next, solder the 1/10W, 2700Ω resistor, on the underside of the board, between the output of Gate 7 and the adjacent pin 11 of IC4. This increases the voltage output of this one gate, as described above.

Testing the Counter

I found it convenient to test each digit as wiring was completed on it. The filaments of the tube require 1.6V. One side of the filament must be connected to the common ground. Connect +18V to B+. Without the +3.6V supply being connected, all the segments of the tube should light up. When the +3.6V supply is connected, the pattern may not represent any number, but should become "0" when +3.6V is connected to the reset line. Any of the segments which do not light up at this point, probably represent a missed solder joint or jumper wire, or a shorted transistor. A segment lighting up when it shouldn't might mean a missed solder joint somewhere between one of the gates and the base of a transistor, an open diode, or a faulty transistor. Since these are all dc circuits, these should be easy to trouble-shoot with a voltmeter.

To test the counting operation, it is very convenient to have a source of negative-going pulses. I used the clock which I had built for this counter, which will be described in another article. It furnishes pulses from 100 kHz to one per second. One pulse per second makes the operation of all the circuits very easy to follow, and you can stop the input pulses whenever you note a problem, and then check the states of all the outputs with a voltmeter, referring to Table 2.

Lacking a convenient source of pulses, you can check the operation of the flip-flops by feeding a sine-wave signal of a volt or so peak-to-peak, and above 100 kHz, into the input of FF1, and checking the Q output of FF4 with an oscilloscope to be sure the circuit is dividing by ten. If it is, very few



The counter with the first two digits completed. Jumper wires are in place. Note a 10K load resistor next to each driver transistor. These are merely to limit the current through the transistor when turned on. The resistors with the light stripes are the 390Ω.

things could be wrong with IC1 and IC2. The output of each of the gates should be near +1V, when all of its inputs are grounded, and it will not harm the outputs of the flip-flops if they are grounded.

If the +3.6V power supply is not well filtered, pulses from the power supply could possibly leak through into the counting circuitry and foul up the counting process, or make the flip-flops count without any input signal. Three nickel-cadmium "D" cells in series, make an excellent power supply for 30 minutes or so, if you suspect this possibility. In fact, the counter could easily be powered entirely by batteries.

With all six digits counting, the board requires 3.6V at about 500 mA, 1.6V at about 270 mA, and 18V with a current demand which fluctuates widely but peaks at about 60 mA with a readout of "111111," and reaches a minimum of about 8 mA, with a readout of "888888."

If you have had a little experience in building solid-state devices and are willing to use care in soldering, this counter should go together with no trouble. The counting logic is extremely simple and the digital readout logic is easy to understand. If you will make sure that you understand the operation of these basic digital circuits before beginning construction it should be a pleasure for you, as it was for me.

. . .WA5LFN

Bibliography

1. Olson, H., "Micro-logic for Non-logical Users," 73, June 1967, p. 58.
2. Jorgensen, E. "Integrated Circuit Crystal Calibrator, 73, Jan., 1967, p. 6.
3. Jones, G., 'An Integrated Circuit Electronic Counter," 73, Feb., 1968, p. 6.
4. Eppley, D., 'Build an IC Decade Divider," *Radio-Electronics*. July, 3968, p. 55.
5. Genter, R , "Built a $10 Experimenter's IC Decimal Readout Module," *Readio-Electronics*, Nov., 1968, p. 60.
6. Genter, R., '9 Digital Readout IC Instruments,' *Radio-Electronics*, Dec., 1968, p. 57.
7. Edwards, A., 'Frequency Measurements with the Electronic Counter," *Electronics World*, Jan., 1967, p. 84.

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REPEAT IT -- THE LONG WAY

Let me be quick to say that this is not just another of the many fine articles on FM or repeaters, as the title may suggest. The availability and low cost of used commercial FM equipment in recent years has brought many hams into the use of channel-type and repeater communications. I would like to introduce you to what I feel might produce results far beyond the present dream of linking the four corners of the U.S. via FM repeaters. Moonbounce is the name of our game, via a system of repeaters!

Two years ago, when our project started, a group of five local hams were already operational on the VHF bands. Many hams had preceeded us there, and many were already quite active on moonbounce projects. Many of these efforts made fine reading, but how many of us have an Areceibo size hole in our back yards, or finances for a large dish antenna on our own?

Since the group is all involved in the electronics field, the idea of researching past articles and ideas came quite naturally. In our jobs, this is done to get a starting point as well as to avoid future patent difficulties. That's when our first problems began. Articles were found, to be sure, but none contained current EME activity, amateur calls, or frequencies in use. What was worse, no column seemed to exist dealing specifically with this area. Since *73* Magazine, with Wayne Green, W2NDS/1 at the helm, seemed to contain more VHF construction articles per column inch than the others we checked, a quick letter to Wayne seemed in order. True to form, he has even offered space for such a column pending enough interest (write Wayne, c/o 73 Magazine) and, of course, finding someone in the know willing to write it. Good magazines are always looking for good articles and good column writers, so try to help if you can. Please contribute where and when you can.

Since this is an "idea" article, I want to present it in a block diagram, no math, no construction format. I will present future articles dealing with specifics. Our idea is a system of many sub-systems which I will divide and discuss independently.

The Links

Most of us don't have the back yard room for a large antenna for moonbounce. Because I do, we had the biggest problem licked. Look around your area, city, club or group. Surely one member has the room, or like FM repeaters, it is for rent inexpensively just outside of town. Remember, no mountaintops are required. 5000 isn't much over a moonbounce path! So look for a low noise area if you can find one. Organize, but don't overdo it, as you will scare off the guy that doesn't feel he has anything to contribute. A club, or even just a group of amateurs meeting together with a common purpose is fine. Communicate! This is where the first building block takes shape. Everyone is busy and can't always make meetings, but we all get on the air. At least this way the XYL knows you are home. Choose a locally *unused* FM spot on 144–220–420 MHz, and get equipment on. I caution you now, please, don't use existing FM channels except to initially keep in touch no matter how tempting. I chose the 420 MHz band, since local activity there is almost non-existent, but this is a good chance to get active on the 220 MHz band as there have been some recent conversion articles for 2m FM gear. Due to the very inexpensive equipment and antenna size, the 420 MHz band may still be your best choice. This usually means building your own 110 VAX power supply for existing mobile type equipment. By all means coordinate, and try to buy the same type of gear so the power supplies, crystals, and other accessories will or can be alike and thus save many headaches. This also can lower the price by group purchasing. Once the equipment is on, you have a "meeting place," any day or hour, and someone else to help you iron out problems. This equipment is not at all lost when moonbounce time comes along. Quite the contrary. It will form the only equipment needed by anyone, except the site chosen for the moonbounce equipment. Plan on adding tone encoding equipment to the control head as you build it in order to be able to control the site from each amateur's home. If the site chosen is in one of the amateur's homes and he is to be present during moonbounce attempts, you don't even need a repeater license.

The Site

The equipment here can be completely a group effort. However, if it is, get the agreement in writing that it is donated to the group effort to avoid future problems and hurt feelings. Most of our site equipment will be my own. Parts and much building help overcome the problem this way. The overall equipment should be "racked," and cabled, and a full set of diagrams drawn. Believe me, this has already saved us much grief. Unless you can work with the equipment daily, and you aren't far enough along to have much gear yet, you would be surprised how much you can forget even if you wired it!

The transmitter should be crystal controlled, preferably using an oven, and CW makes a good inexpensive mode choice. For the purpose of our own experimenting, we will also have NBFM from the beginning, adding SSB as time and finances permit. Build your rack by building blocks, and if you home brew from scratch, add many, many test points brought out to the panel. The blocks will give you a sense of accomplishment as each is added and checked, and the test points allow for fast checks, periodic maintenance, and rapid trouble shooting. By all means build. Why waste a $700 transceiver on a spot frequency job. Get the low level exciter running, and test it unmercifully for local contacts. You may wish to add AM modulation capabilities at this level to increase your number of local contacts. Let it run 24 hours a day, and build it so it will. Use caution concerning fire if the equipment is unattended for long periods. This is why we rack mounted everything (confine it) and temperature monitor all of it (shuts it down). As you add control, identification, and taping functions, allow the exciter to "talk back" on a local 2m link anything sent in on the link. This is exactly what it must do later.

The power amplifier cannot be slighted. Mount it at the EME antenna if at all possible, and go as close to the legal 1 KW as you can muster. One man may have a meter, another a transformer, etc. Anything

less and you may be very marginal. This is one time when you are using the "minimum power to maintain the circuit," per FCC regulations. If you find you need less later, dropping down only buys you nice long tube life and like benefits.

The receiver can be a well overhauled, and in top-notch working order, surplus gear item. This saves money and saves tears if you decide later to modify it extensively. Automatic scanning can be added later for complete remote use. Remember, Uncle Sam pays thousands for these items, so you're not getting junk and you can get a real bargain if you try. The converter/preamp must be top-notch. Here you may have to pool talent or resources or both. You may have to buy one to get on, and later try building from one of the newer MOSFET type articles. This area is totally up to the time, talent, and the funds available within your own group.

I left the best for last, since another article will cover this one in detail. The EME antenna can be as varied as the number of hams actively working moonbounce. If you start with 144–148 MHz, and I suggest you do because of the equipment, stability, and activity, you unfortunately end up with the largest physical size of antenna. However, if you chose carefully as we did, you can later use it for higher frequency work. This is what we did and why.

Our dish will initially be a quasi-parabola, looking at the side like a parabola, and from the front, a rectangle. From the description you can see this is not a readily steerable antenna for a polar mount. It is not. It is driven el-az, or independent elevation and azimuth. If your only interest is moonbounce, by all means stay with polar mount as steering becomes difficult otherwise. We intend satellite work and space shot tracking as well, and thus our decision to suffer the consequences of a complex steering arrangement. Our dish is entirely wood-of-sorts, covered with hardware cloth, and built in 4 ft. by 8 ft. panels for ease of construction and placement. Wood can be very strong and warp resistant if the right types are chosen and it is finished with the proper materials. Multi-element yagis and co-linears are being used, but bear in mind the aluminum cost, single-bandedness, and sheer size of these arrays. The collinears for example are of the 150-plus element type. The size and cost of our dish, the means of mounting and steering it using inexpensive (modified) TV rotators, brings it down to the level of many more amateurs' funds and capabilities.

The Assault

I will present you with the ideas and means we are really using to accomplish our goal – 2m moonbounce. To prove to you that no design work is necessary on your part, many hours of research on the part of the initial members of our groups has been spent compiling the following list of articles that can be directly applied to your efforts. Full credit for these fine articles appears with them, and they are lettered to tie them in with the block diagram. Just to give you an idea of what we did, some are singled out as being our choices.

A. Link Antenna (corner or yagi home stations – gain at site).

1. 432 MHz Corner Reflector Antenna, WA2FSQ, *Ham Radio* November 1971, p. 24.
2. Gain Antenna for VHF/UHF Repeaters, K6MVH, *73* Magazine, July 1971, p. 42.
3. VHF Antennas, ARRL, *Radio Amateur's Handbook* 1964, p. 456.

B. Link Receiver (Motorola T44AAV–Rcvr. TA 141A).

1. Converting 420–450 MHz Equipment *FM Schematic Digest* pp. 61–71, Two-Way Radio Engineers, Inc. Boston, Massachusetts.
2. Converting WBFM Equipment for 420–450, W8FWF, *QST* August 1968, p. 31.

C. Link to EME Interface (COR, Audio transfer, tape amp, etc.).

1. COR Hold-on, WA2KEC, *FM Magazine* date unknown-early issue, p. 35.
2. Understanding the COR K6MVH, *73* Magazine April 1970, p. 41.
3. Amateur VHF Repeaters, VE7BBM, *CQ* June 1968, p. 37.

4. VHF Operation by Remote Control, K6MVH, *73* Magazine, April 1968, p. 37.
5. Mod-2 Digital Identification Unit, WB6BFM, *73* Magazine, April 1971, p. 49.
6. Programmable Repeater Identifier, W6AYZ, *Ham Radio* April 1969, p. 18.
7. IC Repeater Identifier, T. Woore, *FM Magazine* January 1969, p. 15.

D. EME Exciter (we use #1 with modifications).

1. An AM/CW Exciter for 144 Megacycles, W1CER, *QST* September 1965, p. 39.
2. An FM technique for VHF/UHF SSB, DJ4ZC, *QST* October 1970, p. 32.

E. See Item B-1 for oven type crystal oscillators used.

F. Amplifier (we use #3 with modifications).

1. KW Amplifiers for 50—144 Megacycles, W1HDQ, *QST* February 1964, p. 11.
2. Top Efficiency at 144 Megacycles using 4 CX250B's, WØMOX, *QST* December 1961, p. 11.
3. New Ideas for the 2m KW, W1QVF & W1HDQ, *QST* February 1971, p. 24.

G. Antenna System EME (ours is home brew with ideas from all).

1. Simple Antenna Mount for Satellite, Work, W4HJZ, *CQ* October 1966, p. 42.
2. Antenna Tracking Systems for Satellites, GM3BST *CQ* June 1968 p. 55.

H. Converter/Preamp (#1 is our choice).

1. Hi-Performance MOSFET Converter, WB2EGZ, *Ham Radio* August 1968, p. 22.
2. Transistor Preamp for 50 thru 432 Megacycles, W1HDQ, *QST* February 1966, p. 36.

I. Receiver (a much modified BC-348 can be used as tunable i-f).

1. Converting A Vacuum Tube Receiver to Solid State, W1OOP, *Ham Radio* February 1969, p. 26.
2. Converting the BC348Q, WØWIT, *QST* January 1947, p. 19.
3. Converting the BC348O, W3IWX, *QST* November 1947, p. 66.
4. Double Conversion for BC348M, VU2TV, *73* Magazine, November 1968, p. 54.
5. RF Discriminator, K7DEP, *73* Magazine, October 1966, p. 78.
6. Surplus, W2HDM, *CQ* March 1959, p. 47.

J. Below Noise Systems

1. I.F. Tracking Filter for Weak Signal Reception, W8FKC, *QST* September 1964, p. 11.
2. Under The Noise, W2NSD/1, *73* Magazine, April 1964, p. 20.

K. EME to LINK Interface (same as Section C).

L. Link Transmitter (Motorola T44AAV — Transmitter TU204).

1. Same as B-1.
2. 50W on 420 Megacycles (More power for link if needed), WØWGZ, *CQ* April 1952, p. 13.

M This section covers the entire station as a whole.

1. Tracking The Moon-In Simple English, W3SDZ, *QST* January 1965, p. 37.
2. Moonbounce Problem, 28 Mc. and Up, W6VGL, *QST* September 1963, p. 20.
3. Lunar Nomograph, WA6NCT, *Ham Radio* October 1970, p. 28.
4. Appearance of the Moon at Radio Frequencies, W2TTV, *QST* May 1961, p. 21.
5. Mechanisms of Space Communications, K2QBW, *QST* December 1961, p. 22.
6. How High The Moon, WAØIQN, *QST* July 1965, p. 55.

Put this kind of line up together, using the articles for a guide, and a respectable moonbounce station will result. For the obvious cost reason, many amateurs have never tried. I hope it will now be possible for you to share costs and rewards by using a shared system. It should be monitored more, and used more, and this yields more activity.

I would like to acknowledge the assistance (both physical and research) of the following members of our group: K9LNX, K9MKU, K9RYK, WA9BHF, and WA9DTM. Further thanks to all the active moonbounce stations that have helpfully replied to my mailed inquiries. More information can be obtained by stating your question as clearly as possible and sending a SASE to Echo Amateur Radio Group, c/o R.R. 5, Box 39, Noblesville IN 46060.

. . .W9CGI

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Peterborough NH 03458

INTERESTED IN ANTENNAS?

Table-top the Main Features . . . Indoors

Try reflector and director lengths, spacings, numbers, combining yagis, extended-expanded collinears, ¼ wave, ½ wave, and two-half waves in phase for 160 and 80 meters right inside your shack!

Complete construction details for an antenna test set of 432 MHz. Easy-to-build units; a 432 MHz oscillator and a tuned detector are detailed for you. These *rf* units may be used later to build a complete hand-carried solid state portable station on 432, with superhet receiver. This station is described in *73 Magazine* in the article "The 432'er Solid State."

With care and using a small iron you can also test spare or surplus VHF or UHF diodes and transistors lying around the shack, by substituting them in these *rf* sets.

Oscillator Construction.

Figure 1 is the oscillator schematic. A UHF transistor, like a 918 or RCA 2N3600, is used in a grounded-base circuit, which makes it a good oscillator right away. The copper strap over copper-clad baseboard results in quite a high-Q circuit, is easy to couple out of, and tunes over a lot more than just the 420 to 450 MHz amateur band, unless you wish to pad it down and/or remove plates from the Johnson type M capacitor. An output coupling capacitor is provided for better adjustment to the 50 ohm output cable.

Figure 2 is a top view, and Fig. 3 is the side view. This unit is similar to the one in the "432'er, Solid State" article in *73 Magazine,* making it easy to transfer it into the complete rig described there later on, if you wish to do so. There is a slight difference in the dc bias network because in antenna test work a lot (like 100 milliwatts!) of power is desirable, while for local oscillator service in the superhet receiver, lower harmonic content and less power are wanted.

Tuned Detector Unit.

The schematic is in Fig. 4, the top view is Fig. 5, and Fig. 6 shows the side view. The detector diode unit is also similar to the "432'er" mixer unit, except that the *if* coil is not installed and the dc output is brought out of the *if* jack. Be sure to leave space for the *if* coil if you want to use this detector later on as a mixer.

Operating the Antenna Test Sets.

After building the *rf* units, set up two card tables, one for the oscillator and transmitting antenna test units, the other for the receiver antenna and tuned detector, as in block diagram.

Next step. Go over to the other card table and set up the tuned detector. This is very convenient for indoor work, as you will see. For checking directivity, good gain measurements. Getting away from the "near field" are some of the reasons for the two tables.

The diode detector needs no battery but you will need a good meter, which should be a 50 mA unit for best sensitivity. You can use a heavier meter, but it will just not be as

sensitive, and will require the two tables to be closer together.

Plug the antenna cable into the detector jack No. 1, and the other end into the dipole jack. Tune the detector to 432, and you should then have current showing, if the antennas are only a few feet apart to start.

Important Notice!

As soon as possible after positioning and tuning up a dipole, reflector, and director, set up at least a three-element beam to use as the receiving antenna for the test meter, and point it at the transmitter antenna under design and test.

A simple three-element unit for 432 is shown in Fig. 7, as a sample of what can be done for the purpose of getting started. You may well tune up a *better* one which you can then scale up to six meters, ten, or whatever band you wish. Nothing prevents you from using as many elements as you want to tune up! Three elements are handy for indoor work.

The use of a three-element (at least) beam eliminates a great deal of nuisance reflection, including *yourself* as you move about. The stability of the detector meter when two beams are pointed at each other is remarkable. Such an antenna, for test purposes, can be used for reception of energy from any other type of antenna you may wish to try.

Cable Matching

You will notice a trimmer capacity on the radiator. This is an important little item, as you will see when you adjust it. It is part of the gamma match, and quite necessary (as you can find out by shorting it out). In general, use more capacity for lower impedance, with closer spacing. Use quite a bit less for the dipole alone.

I use a long-handled fiberglass screwdriver and adjust the capacitor from *in back* of the reflector, readjusting the spacing and oscillator tuning each time. This can be important. You also can vary the *length* of the gamma match and its *spacing* from the radiator.

When you get that antenna "matched to space," which is exactly what you're after, you'll see the difference.

Of course you can try other types of feed too. An intriguing type which can give you a perfect match to a 50 ohm cable is shown in Fig. 8. I "invented" this style while with a large antenna project on Commonwealth Avenue in Boston about 1957, and it won out over a "conventional" dipole with stubs and all.

Cable Length

This is also important to check. The only time cable length is *not* important is when you have a perfect match, and usually that is never! Just try it. If you can add an eighth wave or a quarter wave and not change results on the antenna, that is an absolute check on vswr.

Radiators, Reflectors, and Directors

The results should open your eyes. For example, let's see you try to tune up a three-element job with close spacing, like a tenth-wave!

Get yourself an extra roll of aluminum clothesline and some more dowel wood at the hardware store and have *more* fun. Cut reflectors, 5, 6, 8, 10, and 15% *longer* than a half-wave in free space, and see what happens. Let yourself go!

Get still more aluminum and try 5, 6, 8, 10, and 15% *less* length for the directors. You may have *more* surprises. I have only described material for two three-element beams, to illustrate the basic principles and tuneup of reflectors and directors, but don't let that stop you from adding as many more elements as you wish to try.

My biggest so far was the 36-foot-long job, with 16 wide-spaced elements on two meters that I used on mountain tops. Incidentally, each director you add to the beam should have a length of a little less than the previous one, till you get about half a dozen tuned up and placed.

Just a word about many-section yagis. After the "launching section" is tuned up, comprising those first half-dozen or so, the rest of the directors *can* be the same length. I have never found it possible so far, however, to sue the same *spacing* for numbers six to sixteen. You *can* do this, like some of the commercial lads, but I have not found this to give maximum gain which is what I've always been looking for, personally. You will be able to check this yourself with this antenna setup. You will

also see that every director you add will *increase* your gain, even the *last* one you add.

Sheet Reflectors

If you want to pursue this matter further, get some aluminum sheet at the hardware store. Better yet, for the dollars involved, get some aluminum flashing and try various sizes and spacings for sheet reflectors. Take a large piece of sheet, such as 18 x 18 inches (not critical) and mount it on a movable dowel like the other reflectors, and watch that meter. I have always found that the tuned reflector (some 10% greater length than the radiator) has better gain than the sheet reflector. Also check the front-to-back ratio with the sheet reflector; it could be better.

Two Yagis Together

As you see, this can go on and on. Don't say I didn't warn you. Just try for fun adding two yagis together. Or better, try adding two dipoles first. You will soon see that even two dipoles have to be spaced greater than a half wave for best performance. This is because the capture area of even a dipole extends out beyond the half wavelength.

It wasn't so long ago that I used to manufacture and sell collinear arrays, as owner of the UHF Resonator Co., Rye, N. Y. These were spaced only a half wave and did not have the gain they should have had. This was because a "time-honored" method of feeding a collinear beam in all the books shows the half wave line as a matching section, which precludes anything *greater* than half-wave spacing.

The day came, however, after reading about capture area for the umpteenth time, that I felt I should check this item out for the two-element yagis that compose most collinear arrays. This is a large part of the deal. The collinear, as usually made up, has *reflectors* as well as dipoles so that you are really combining two yagis together with every two sections of the collinear. And, two yagis *must* be spaced much wider than the half wave if you do not want the capture areas to interfere. When they do, you are just putting up more aluminum than you are using. Check it out for yourself.

Match up a good radiator and reflector, then make a second identical one and check it out for similar gain and directivity. Then connect both together as a four-element array composed of two yagis, using equal length cables for phase maintenance. See Fig. 9. You should join the cables close to the oscillator, or use a quarter-wave matching section of 35 ohm cable. This is because joining two 50 ohm cables makes a 25 ohm impedance at the joint.

Start with the reflectors almost touching and the yagis side by side, which is the way they are in a collinear array. Fig. 9 shows them already "expanded." When you get them set up, watch the meter as you pull them apart – what a revelation that was when I first did it.

80 and 160m Beams

Figure 10 shows a setup on 432 MHz for checking end-feeding of a half-wave antenna for 80 and 160 meters. If you have the territory, two of these, known as two half waves in phase, makes a very powerful antenna for 80 or 160 meters. This is shown in Fig. 11. Note the low capacity of the end fed coupling units. This is important, because you should *not* load a half-wave antenna directly onto a tuned circuit, and expect much tuning.

Marconi Types and Angle of Radiation

Put a piece of that aluminum flashing on the table, add a little wet earth (maybe not in the living room) and add a little salt if your shack is near the ocean. Now you can check verticals against ground, and ground effect of high gain beams, which shouldn't be noticeable if your beam is putting 90% of its energy out in front, which it must do to have some 10 dB gain.

With a little ingenuity, wooden dowels, and still more aluminum (or maybe you can use smaller copper wire for these tests), you can check scale model quads, halos, stacked halos, hula hoops, big wheels and almost anything you can dream up. Of course you're now getting near the professional style of antenna scaling. But maybe that isn't too bad.

Gain and Front-to-Back Measurements

There is a positive way of checking the

Symposium continued from page 3

FM SYMPOSIUM SEPTEMBER 24TH

The release of the repeater regulations by the FCC with an October 9th deadline for comments demanded some fast footwork by repeater groups if they were going to be able to intelligently respond to the situation.

After waiting for several days for the Northeast Repeater Association to get into gear and come up with a meeting, and after it became obvious that this group would not get together before their annual meeting on October 7th, far too late for repeater groups to return home and organize a response to the FCC order, 73 Magazine hurriedly set up a meeting place in Waltham (Mass.) and announced it in the Repeater Bulletin.

The Bulletin, by the way, was in the mail to its subscribers on Monday September 11th with the full text of the new regulations which were released on Friday the 8th! The order had been tentatively released about ten days earlier, but it took some time to actually get printed and mailed from the FCC.

The Waltham symposium drew representatives from nearly 30 repeater groups, not counting multiple representation by individuals, some of which claimed to represent up to eight repeaters. Despite repeated attempts of NRA representatives to interfere, the meeting went very well and its objectives were met.

220 MHZ BAND PLAN

The frequency coordinating committee of K1KEC, K4GGI/1 and F2BO/W1 were all present and had come to the meeting prepared to explain their plan for the modified 220 MHz band. This committee has been working together for several months organizing the New England repeater frequencies – with spectacular success and cooperation. It perhaps should be explained that this committee pre-dated the NRA and agreed to work with NRA when that group was formed since it seemed beneficial to get together with them

The committee did not expect to find NRA officers demanding that they keep their work a secret from New England repeater groups in order to give more prestige and power to NRA, but this is just what happened. NRA said no, you cannot be part of NRA if you do not do what we say – and we say you cannot present your 220 MHz plan at Waltham, but must hold it until October 7th for the NRA meeting.

When this fact became known to the Waltham symposium repeater representatives, their anger and irritation with the high-handed actions of NRA grew noticeably.

The plan was presented anyway – and adopted by the representatives. It consisted of using a 1600 kHz split with repeater input on the low end and output high, starting at 224.98 and working down every 40 kHz. This leaves a few channels in the middle to avert repeater outputs getting into other repeater inputs. Simplex 223.50. Agreed also to leave 222.0 to 222.3 open for weak signal work for the time being. Late word has it that the California Amateur Relay Council has approved the same plan – and NRA is expected to put its stamp of approval on it.

VETO REGULATIONS

The group discussed the new regulations in depth. The pros and cons of the entire order were considered and the vote was taken on whether the group preferred to go with the new regulations, hoping to change them later, or to stop everything and continue with the regulations (or lack of them) the way they were. The vote was, with one exception, opposed to adopting the new regulations.

The complete report on the Waltham symposium is in the Repeater Bulletin ($2 per year as yet).

. . .Wayne

actual gain and front-to-back ratio of beams which will not cost you a cent. This method is simply the distance method. Twice the distance (with equal power showing on the meter of the detector) is a power gain of four times. How could it be simpler than that? A gain of 3.33 in distance equals 10 dB in power. This of course is in free space. If you really match up your *dipole* radiator for maximum output and find it registers 50 on the meter at ten feet, then substitute your new tuned-up beam and find you can go out to one hundred feet with the receiver array and still have it register 50, you've got a 20 dB beam! I should warn you though that *that* amount of gain takes a beam of about six wavelengths square, which, even on two meters, is some 36 feet *on a side.*

There can also be some ground effect, so you should average it out by raising and lowering one or both of the beams up and down to check.

The front-to-back-ratio check is equally easy. With the main signal on, go around to the back of the beam with the detector, meter, and receiving beam in your hand. Adjust your distance in back of the transmitting beam for a low reading on the detector. This is probably what you'll get anyway. Then go around in front. The difference in distance is the front-to-back ratio, naturally. Don't forget, for the power ratio you have to square the *distance.* Good luck on that one.

Remember the law on antennas, "Gain is equal to directivity." Under certain conditions, not generally encountered nor desirable, you can get directivity without a corresponding gain, but never gain without directivity.

It is generally considered that a beam tuned for maximum forward gain does not at the same time have a maximum front-to-back ratio. This is more evident with three-element beams than with high-gain jobs. You can check yourself with these test sets, plus a little more aluminum, wood, and time.

That's about it, so hope you have as much fun as I do with these kind of tests. It seems that every time I work with antennas, even after some 44 years of it, there are still new things to be learned. . . . K1CLL

W. Edmund Hood W2FEZ

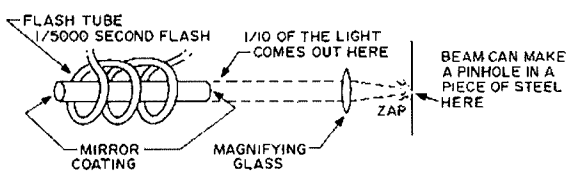
ALL ABOUT LASERS

The atomic spy stood on the shores of Jupiter's Red Lake and focused his radar binoculars on the enemy ship 1100 miles away. Then with savage sneer he drew his laser pistol. There was a resounding "ZAP" and a blinding flash. The ship was instantly vaporized.

This is the picture most junior operators get when they hear the word laser. Well kids, I hate to spoil your dreams, but it just isn't so. There isn t a laser in the world that could destroy even a toy ship. In fact, the average laser doesn't generate as much power as a 22 calibre bullet. Believe me, I know. I've built 'em. The big thing about a laser isn't how much power it generates, but how it's concentrated.

The word laser comes from the initials of the words, "Light Amplification Stimulated by Electromagentic Radiation." This means that one kind of energy is pumped into the laser, and another kind comes out. It doesn't "create" energy.

The heart of the most popular kind of a laser is a solid ruby about the size of a cigarette. (I've seen them much larger, but this is average.) Each end is plated so that it will reflect light. The plating of one end is thin enough so that it will let out about one tenth of the light and reflect the rest. The ruby is surrounded by an electronic flash lamp similar to those used by photographers, only much more powerful. The power supply for this flash lamp can weigh several hundred pounds. (That's why they haven't built many laser pistols.)



RUBY LASER

When this flash lamp goes off, nearly all the light is forced into the ruby by a system of mirrors. This starts a chain reaction in the ruby which generates more light. The light generated inside the ruby is very pure – that is, it's only one color, while the flashlamps were, like most lamps, a mixture of many colors. The light within the ruby cannot get out through the sides, so it tries to come out the ends. The reflective coatings on the ends causes it to bounce back and forth through the ruby. Each time it passes through it makes the ruby generate more, until it gets so powerful that it shoots out through the thinner reflector. All this takes place within a few millionths of a second.

When the light comes out of a laser, it doesn't spread out as the light from a flashlight would. If the beam is ¼ in. wide as it leaves the ruby, it will still be ¼ in. wide a mile away. This is what makes a laser beam so valuable. You don't lose any power at all. An ordinary light would spread out and much of the power would be lost, but a laser beam sends all the light where you want it. And, if you could see the light waves, you would see that they were all the same wavelength, and all vibrating in the same direction, or as the scientists say, they are all *polarized* in the same direction. This way, no matter how far you send the beam, you can recover all the energy at the other end.

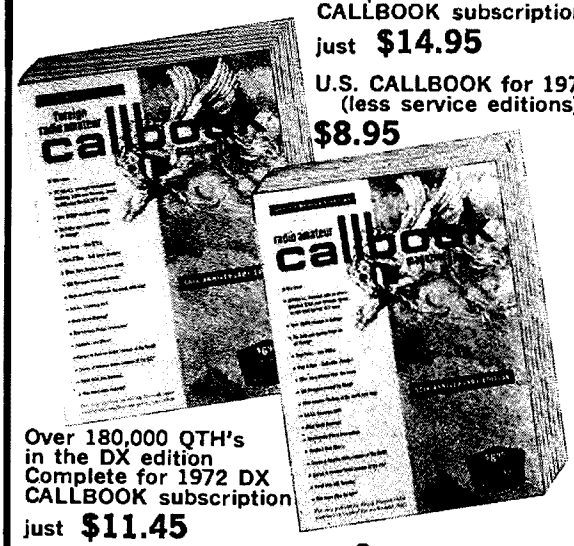
Anybody knows if you take a magnifying glass and focus the sun's rays into one tiny spot, they will burn a hole through a piece of paper. Now sunlight contains many colors, and each color will focus differently from the rest. When you try to focus sunlight with a magnifying glass, the best you can do is come close for all but one color. Not so with a laser beam. Since it contains only one color to begin with, you

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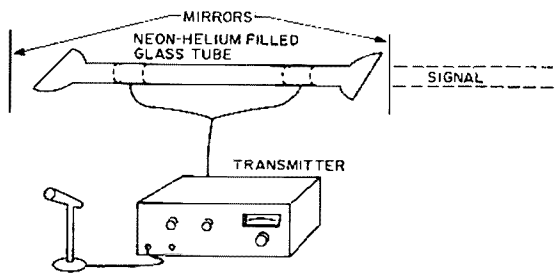
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can get all the energy into one tiny point. When you gather it all together, a little bit will go a long way. In fact, a flash that lasts only 1/1000th of a second will, if concentrated by a magnifying glass, burn a hole through a piece of steel such as a razor blade. However it would be very impractical to use a laser beam to make a hole in an enemy warship. You would have to have somebody near the ship to hold the magnifying glass, and the enemy might not like it.

Seriously, though, while you can't sink the Queen Mary, or vaporize Newington CT with a laser, it still can be used to do a lot of good. For instance, hospitals use them to weld the tissue on the inside of an injured eye. Before lasers were discovered, that was an impossible operation.

So far I have only discussed the ruby laser. There are several other kinds. For instance, a gas laser, made of a glass tube something similar to a neon light, is one of the most promising kinds. The glass tube contains a neon-helium mixture and is excited by a radio transmitter. The laser beam is steady rather than a quick flash, and if the beam is modulated messages can be sent with it. A communications laser can be beamed exactly and sent to only the receiver it is meant for. Hams have long ago communicated with laser beams over hundreds of miles. One type generates a microwave signal instead of visible llight. This is called a Maser.



GAS MASER

Eventually,I suppose,somebody will figure out a way to make a destructive weapon from a laser. Meanwhile, without getting fantastic, this fascinating beam of light holds a lot of promise, and beckons invitingly from the doorway of an amazing space-age world of incredible technology.

. . .W2FEZ

Douglas S. Byrne G3KPO
Jersey House, Eye,
Peterborough, England

Here is a quick-switch antenna patchbox, with built-in transmatch and dummy load.



Put 'Em All In One Box

o you already have half a dozen different transmitters, a like number of antennas, plus a transmatch, dummy-load and rf-ammeter?

OK, OK, but how do you connect up this lot, eh? My bet is with odd lengths of coax, alligator clips, or even, like me, by twisting together odd bits of flex, kept in the sockets with matchsticks . . . right the first time?

Of course this is all in the true amateur spirit, but is really the quickest way to get the wires crossed – literally – and maybe sustain a nasty rf burn (and don't they take a long while to heal up?). And it can be just as painful to the pocket when you inadvertently put things to the "smoke test" . . . such very expensive smoke!

All such dangers can be eliminated by knocking together this nifty little unit which combines a switched antenna patchbox, transmatch, dummy-load, and rf-ammeter.

You'll wonder how you ever did without it when you find you can instantaneously switch *any* of your transmitters to the dummy load or any antenna. And switch so quickly that a *true* comparison can be made between different antennas – both on reception and transmission. Valuable time is also saved in contest working.

It will be noted at once that this unit embodies only the best ergosonic principles! The various inputs from the transmitters are on the left hand side, right next to the switches so as to keep the leads short. The meter is in the center, the tuning knob is on the right, and output sockets to various antennas are on the right hand side of the cabinet. To keep them cool, the dummy-loads are on top (actually, there's no room inside), while the high-Z output for the

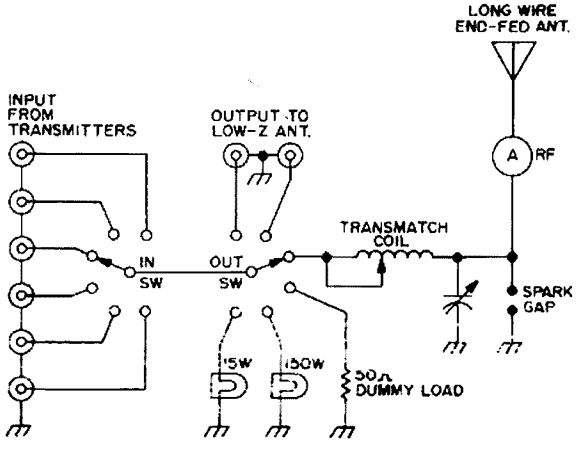


Fig. 1. Inputs from the various station transmitters enter on the left and are switched either straight-through to low-Z antenna, or alternately to the dummy-load, resistance, a load-bulb, or the transmatch "rotary-roller" tuner feeding the long-wire antenna.

end-fed longwire is way behind the capacitor, where it is more or less safe from straying fingers.

The basic requirement of this particular magic box is the Coil Aerial Tuning No. 2A for the Canadian Marconi No. 52 transmitter, currently available on the surplus market. This consists of a massive "rotary

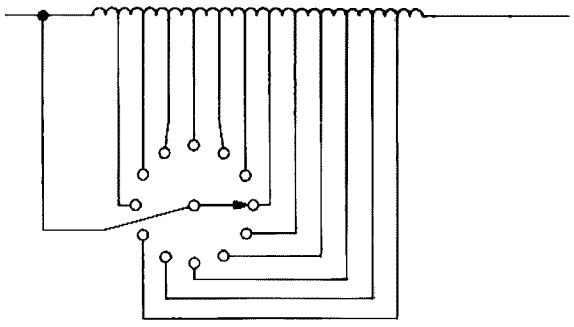


Fig. 2. No roller coasters in the junkbox? Then wind a coil of 30 turns on a 2½ in. former, and short out every few turns by means of a 12-way Yaxley switch.

roller" tuning coil and vernier dial reading up to 1326, which gives it excellent resettability. The coil is mounted on a steel metal panel, which is nicely sprayed grey, but the cabinet is typical "Army finish," and looks much better after a rubdown with sandpaper and a fresh coat of matching paint.

Although there is just room inside to mount the two switches, which were from an old TU5B unit, both the dummy-loads and tuning capacitor have to go up on top.

Now, if this particular item of "desirable surplus" is unobtainable, no need to worry, as practically *any* rotary coil of reasonable size will fill the bill – say, a coil of two to four inches in diameter, and from 30 to 40 turns.

What, no roller coasters in the junkbox? No matter, just wind a tapped coil and short out every few turns by means of a 12-way Yaxley switch, as in Fig. 2.

The tuning capacitor can be of any medium size, somewhere between 100 and 300 pF will be quite OK, but it *must* have wide-spaced vanes – at least as wide as those of the tuning capacitor in the PA tank circuit, otherwise it will spark across on peaks.

The dummy-load is a 50Ω high-current carbon resistor, ten inches long and an inch in diameter, mounted on three-inch standoff insulators. Keep it away from other components, as it dissipates all the rf output of the transmitter when in use, but as this should not be for more than a few minutes at a time under normal conditions, it can be over-run without too much harm. Switch it off when it smokes!

If you do not happen to find a large resistor of suitable value in the junkbox, wire up a string of smaller wattage ones in series-parallel to make the total resistance around 50Ω. Remember that they must all be carbon, not wire-wound, and given plenty of air space to cool them.

The meter shown in the photo is of the hot-wire variety, scaled to 1.5 A, but a thermo-couple type would be as good or even better, as its action would be quicker. The actual current shown varies considerably from band to band. Why not try an 0.5 A meter with a switch to shunt parallel resistances across it as required (see Fig. 3).

Bulb-holders should really be of the pot type, but Bakelite works all right clear up to 30 MHz. The high-impedance output to the long-wire end-fed antenna must exit through a porcelain "feed-through" type of standoff insulator, as there can be considerable rf voltage at this point on some bands.

Internal wiring should be as direct as possible, using short lengths of coax cable; please do *not* forget to ground *both* ends of the outer casing. All metalwork should be bonded with copper strip, not wire, and the unit itself bonded to both transmitters and station ground.

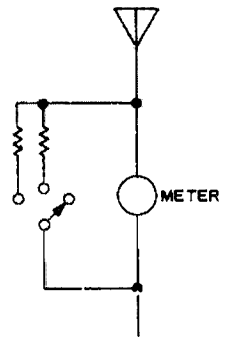


Fig. 3. If your meter knocks against the end-stop on some bands, wire a switch and shunts in parallel. Low-resistance shunts can be made out of old fire-element wire.

It is certainly not advisable to rely on the outer-sheathing of the coax cable for grounding purposes, as this can cause all sorts of problems, including getting a quick kick off the controls.

Your low-pass filter, swr bridge, and T/R relay should be wired together in the order

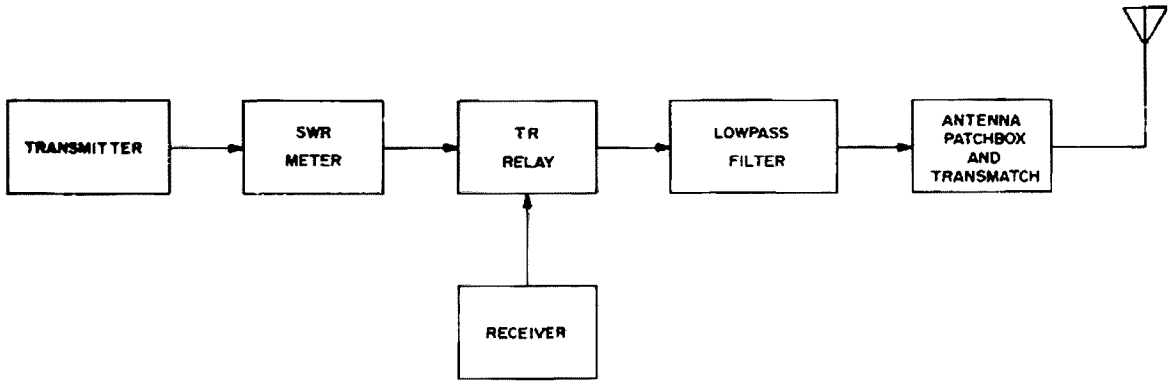


Fig. 4. The swr meter, T/R relay and low-pass filter are placed this way for minimum harmonics.

shown in Fig. 4, in order to keep harmonics down and TVI to a minimum.

Modus Operandi

First, plug in coax leads from the transmitters, and do the same with the antennas. The output is switched straight through to low-impedance center-fed dipoles, ground-plane, and quarter-wave Marconi, but the end-fed random-length job (the one to the end of the garden!), is hitched to the standoff feed-through insulator, and fed via the transmatch.

Switch to dummy-load and tune the transmitter in the normal way. Flick the output switch to "transmatch," with the vernier dial at zero. Put the capacitor vanes at half-mesh, and wind away on the roller coaster handle until the rf-ammeter reads maximum. At this point, the meters on the transmitter should be back practically where they were when tuned into the dummy-load.

The capacitor can be used for final trimming, but remember that, when correctly loaded, the tuning should be very broad so that considerable movement of the knob will be required to produce any significant change in meter reading. This is the condition of highest efficiency, when the transmatch coil itself consumes a negligible amount of power. All the rf watts are going "right up the spout," where you want them, instead of chasing their own tail round the transmatch tuned circuit!

Although the roller-coaster coil will match any random-length of antenna into the low-impedance pi-output circuit of the transmitter, it should be realized that the actual amount of inductance required in circuit in the transmatch will vary considerably from band to band. For if the antenna happens to be a half-wavelength long (or a multiple of half-wavelengths), then it will present a high-impedance to the transmatch, so that quite a lot of coil will have to be "wound-up" in order to match the widely differing impedances. Whereas, if the antenna is a quarter-wave (or multiple) at the working frequency, then very little lumped inductance will be required in circuit.

The great beauty of the roller coaster is that there are no coils to change, no tappings to adjust, and nothing to do except wind away on that handle and stop when the rf-ammeter reads maximum. Once the correct settings have been noted (there's even a small plate provided on the front panel for this very purpose), it can be reset in a jiffy, without even using the dummy-load.

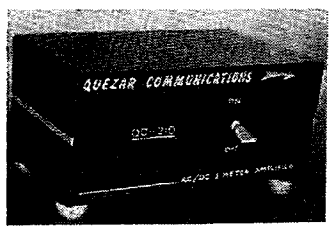
The Light Bulbs

While an electric light bulb does not make a precise dummy-load, as its resistance varies widely as it warms up, it is still a very useful guide when making adjustments to the transmitter. One instance is in modulation checks, for it gives a clearly visable sign of upward as well as downward modulation, and also the percentage of modulation as you whistle merrily into the mike. (Cries of Shame!) One bulb can be 10 or 15 watts for low-power jobs, and the other 150 or 250 watts for the QRO rigs.

The second use of these bulbs is in making a fairly accurate estimate of the actual rf output of a transmitter, together with the efficiency of the PA. For this purpose, two identical bulbs are used, one being wired to the 117V mains, and the other to the transmitter output. When they

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glow with exactly the same brilliance, obviously the wattage will be identical. A sheet of ground-glass placed in front of the two bulbs will assist in balancing, and of course keep bright lights away from the unit when judging. The efficiency of the PA is easily worked out by reading the final plate voltage and current meters. This experiment shows very clearly how the actual efficiency falls quickly as the operating frequency rises – try it and see the great difference between 80 and 10!

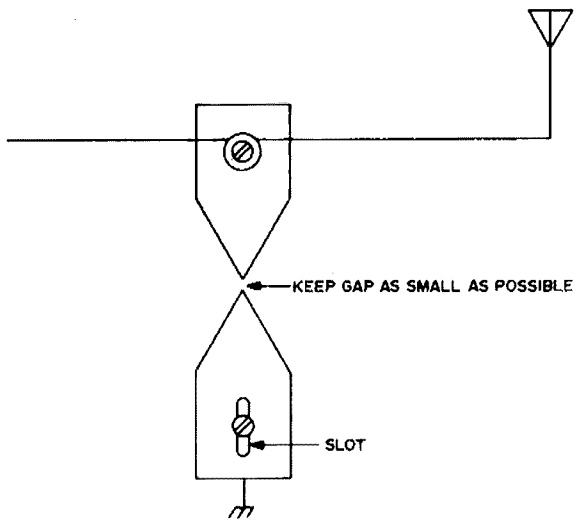


Fig. 5. This lightning-arrestor and static-discharger is easily made from odd scraps of copper strip or tinplate. In order to make adjustment of the gap easy, cut a slot in one plate so that it will slide up and down the fixing-bolt.

Whereas dipole antennas are normally grounded via their coax cable, the sheath going direct to ground in most cases, provision should always be made to ground long-wire antennas. This can easily be arranged inside the box by fabricating a little static discharger out of odd bits of copper or tin, as shown in Fig. 5. Keep the gap as small as possible, but not so that it sparks merrily when you press the key!

The photo was taken outdoors one sunny day with my ancient Leica. Technical details are: hand-held (very shaky) pan-X, 1/20th at f.12.6., developed in . . . but heck, what's all this photographic nonsense to do with 73 Mag?

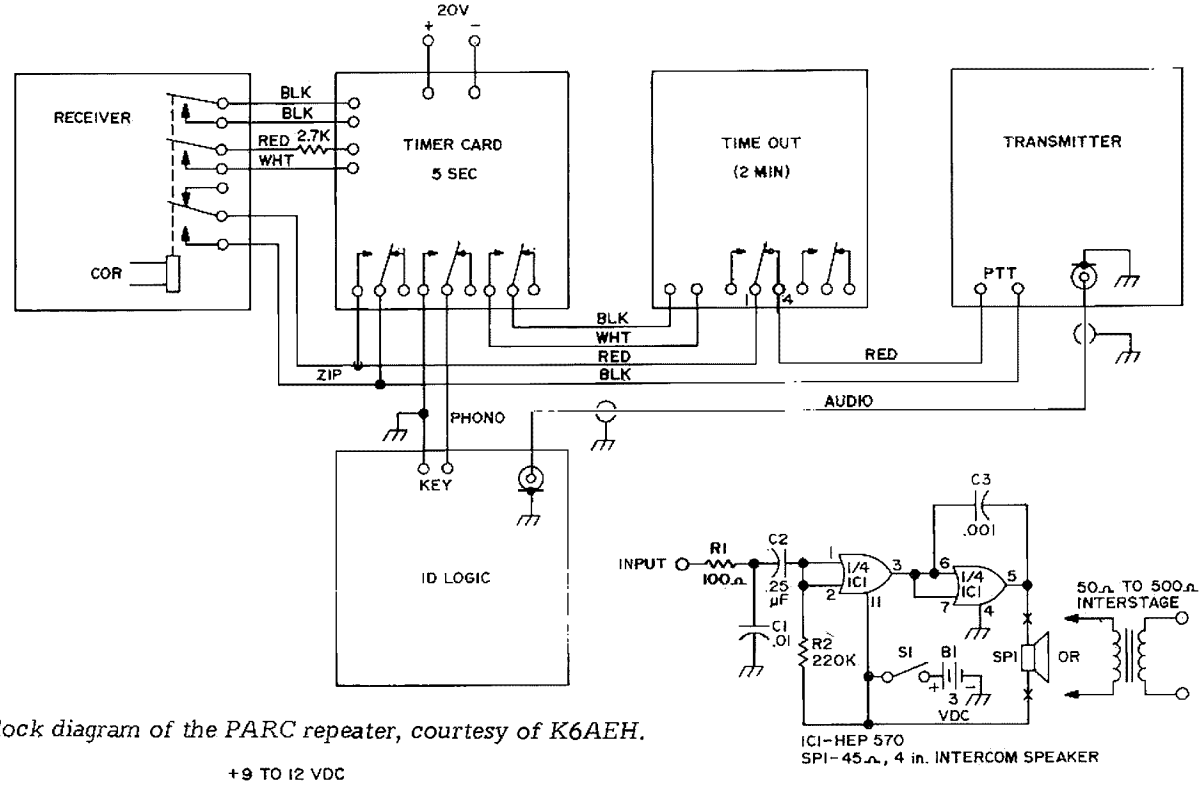
Absolutely nothing at all, except that a lot of amateurs are also keen cameramen. And, it's one way of ending an article.

. . .G3KPO

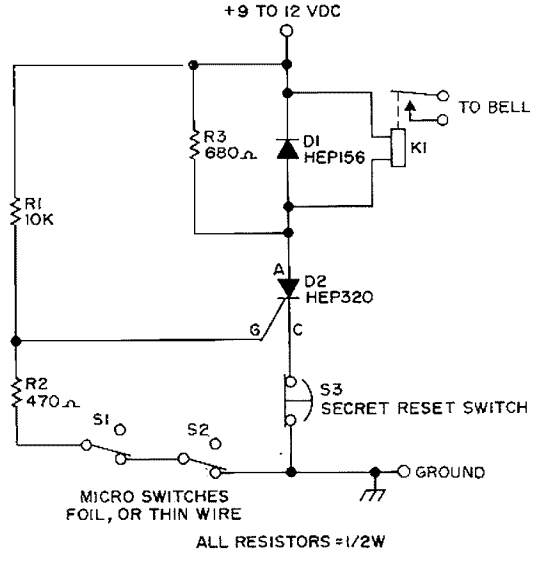
CIRCUITS, CIRCUITS, CIRCUITS...

The following circuits have appeared in the referenced books, magazines, application notes, etc. While we try to reproduce all of the information that should be needed by an experienced constructor, readers may want to avail themselves of the original sources for peace of mind.

Readers are requested to pass along any interesting circuits that they discover in sources other than U.S. ham magazines. Circuits should be oriented toward amateur radio and experimentation rather than industrial or computer technology. Submit circuit with all parts values on it, a very brief explanation of the circuit and any additional parts information required, give the source and a note of permission to reprint from the copyright holder, if any, and the reward for a published circuit will be a choice of a 73 book. Send your circuits to 73 Circuits Page, 73 Magazine, Peterborough NH 03458.

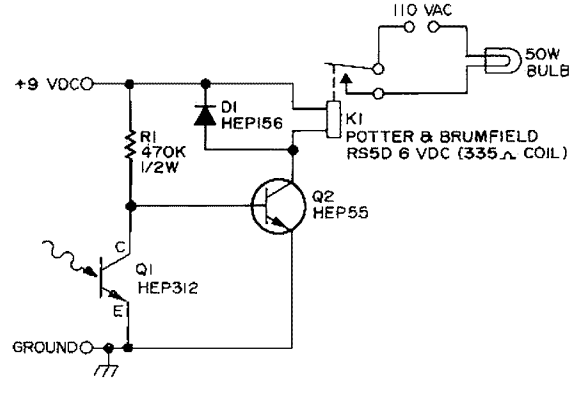


Block diagram of the PARC repeater, courtesy of K6AEH.



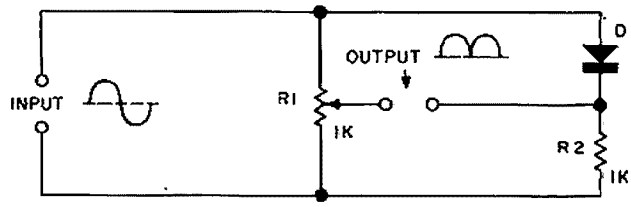
This burglar alarm will turn on a siren, bell or silent warning device. Additional switches may be added in series with SW1 and SW2; foil or thin wire may be used instead of SW1 and/or SW2. Courtesy of Motorola Construction Projects HMA-37.

***Microphone** or audio amplifier, Class A, high gain **and compact.** Circuit courtesy Motorola from their **Radio Amateur's** IC Projects, HMA-36, available **free from Mo**torola, Dept. 73 Box 20924, Phoenix AZ 85034.*



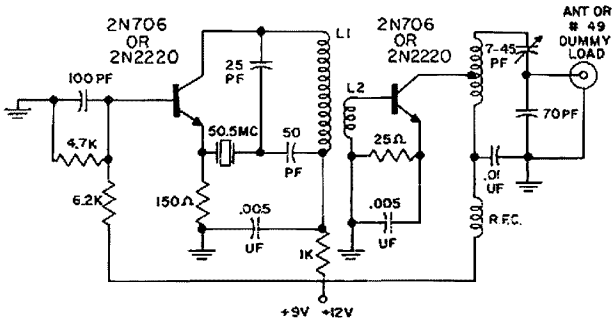
*Automatic night light that turns on at dusk and off at **sunrise.** Courtesy of Motorola Construction Projects HMA-37.*

MORE CIRCUITS...



Single diode full wave rectifier. Adjust R1 while monitoring the output waveforms on an oscilloscope. When both humps are equal, the setting is correct.

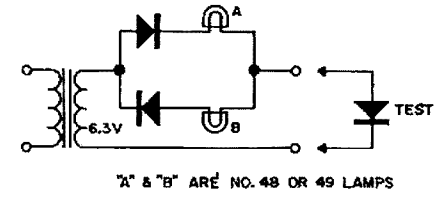
K6AI



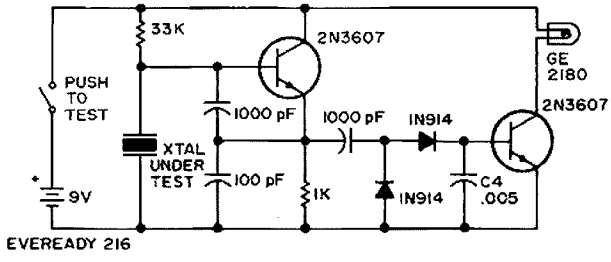
L_1—¼" dia. 7T #24
L_2—2T at cold end of L_1
L_3—6T Airdux 608 (B&W 3010) CT
RFC—20T #26 on 1W resistor

100 mW 6 meter transmitter. Modulate AM with a TA300 IC or FM with a couple of diodes.

K0VQY

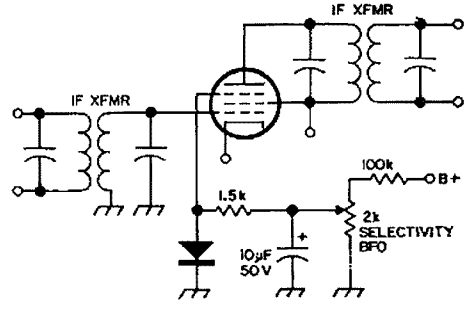


This simple device gives a quick check of diodes. If lamp A lights, the diode is good. If B lights, the diode is good, but connected backwards. If neither lamp lights, the diode is open, and if both light, it is shorted. From the Diode Circuits Handbook, edited by WA1CCH, available for $1.00 from 73.



Xtal checker. When the button is pushed, a good xtal should cause the bulb to light.

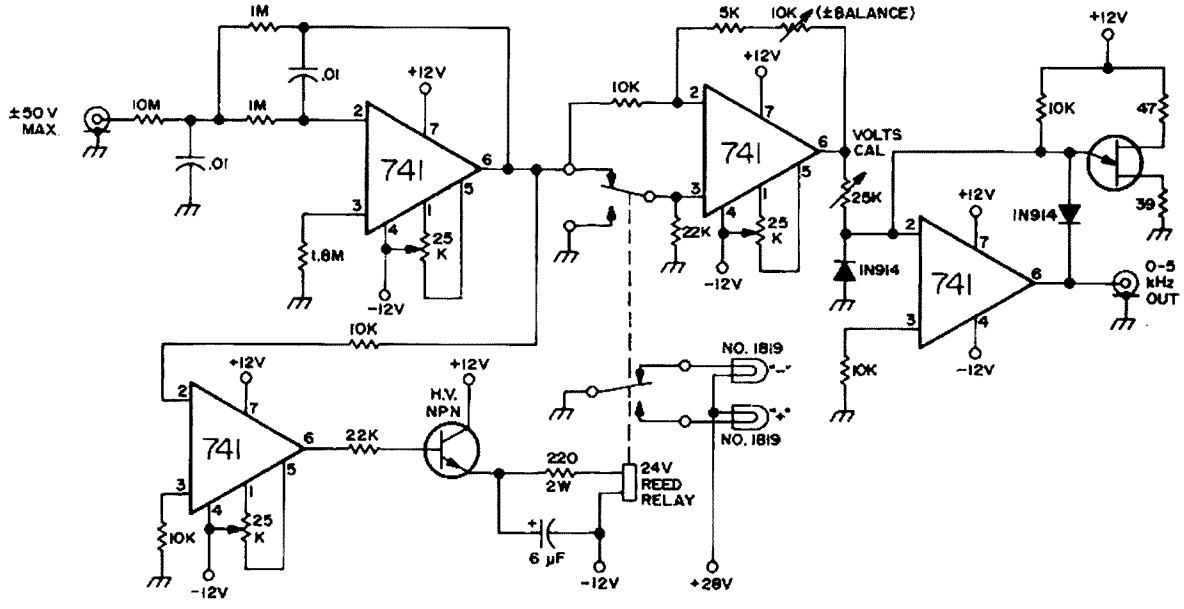
K6VCI



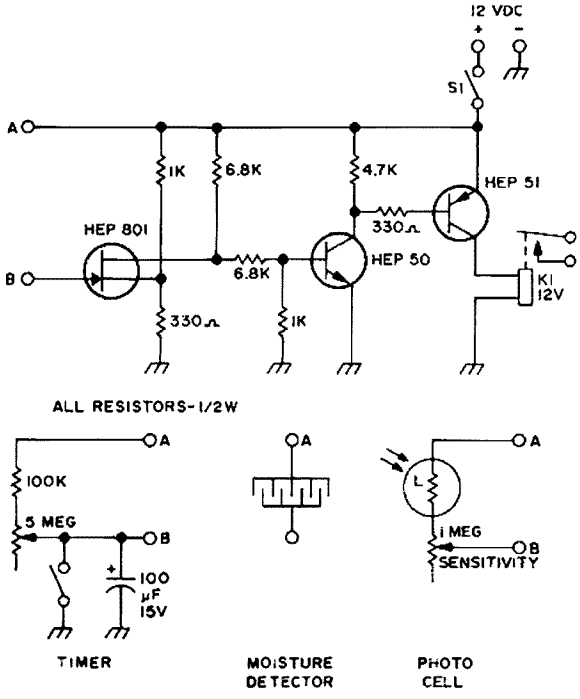
Adaptor to provide SSB/CW reception and Q-multiplication in a receiver. From the Diode Circuits Handbook, edited by WA1CCH available for $1.00 from 73.

USA TELEVISION CHANNEL FREQUENCIES

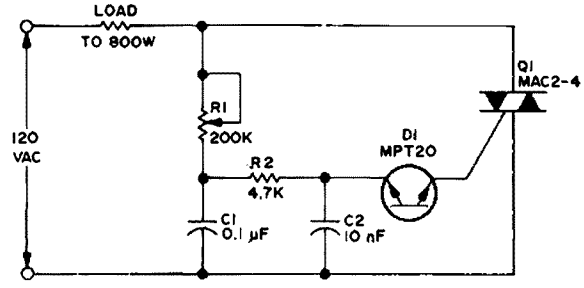
VHF CHANNEL	FREQUENCIES	CHANNEL	FREQUENCIES
2	55.25–59.75 MHz	8	181.25–185.75 MHz
3	61.25–65.75 MHz	9	187.25–191.75 MHz
4	67.25–71.25 MHz	10	193.25–197.75 MHz
5	77.25–81.75	11	193.25–197.75
6	83.25–87.75	12	205.25–209.75
7	175.25–179.75 MHz	13	211.25–215.75 MHz



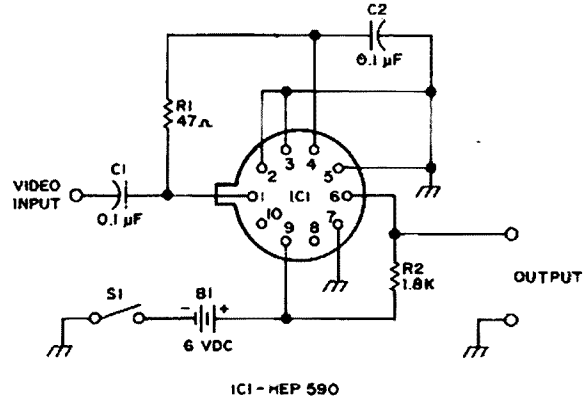
DVM adapter for a frequency counter. This circuits consists of a 200 k-ohm/volt input low pass active filter stage, a polarity detector and automatic switcher/indicator, and a voltage-to-frequency converter. The output frequency is adjusted so that 50 volts input will give a frequency of 5000 out. The three 25K pots are used for offset balancing. Any counter capable of readout to Hz is fine. Circuit by WØMLD.



Basic control unit which can be used for almost anything . . . timer, light activated relay, moisture detector, etc. The timer circuit will range from about 5 seconds to 50 seconds. Change R and C to alter range. The moisture detector normally uses a small printed circuit board with interlaced wire network to allow moisture to bridge the contacts. Light relay operates when light strikes the cell. Circuit courtesy Motorola HMA-33 Tips on using FETs.

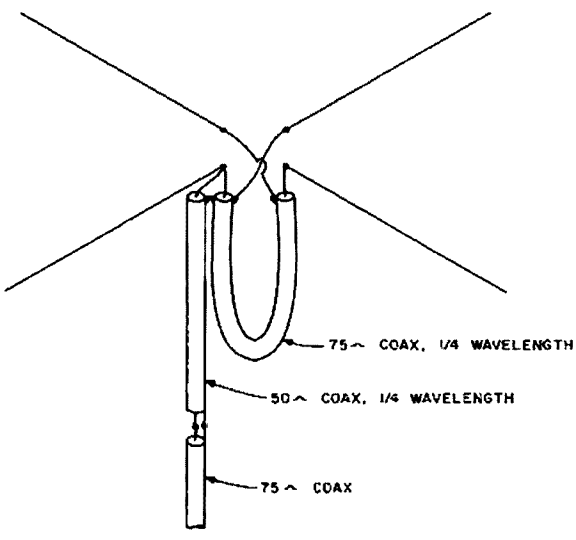


Light dimmer which will handle up to 800 watts of incandescent lamps. 10 nF = .01 µF, by the way. Circuit courtesy of Motorola Semiconductor Power Circuits Handbook.



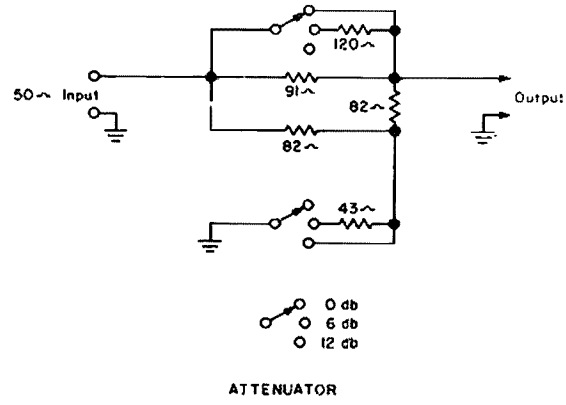
Video amplifier using a HEP 590 IC, courtesy of Motorola.

MORE CIRCUITS...



TURNSTILE HOOK-UP

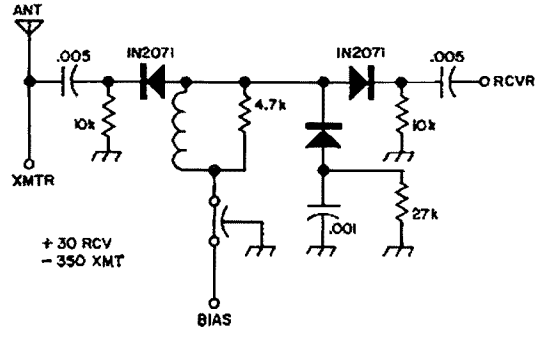
The Turnstille antenna, two dipoles phased 90° apart, is an omnidirectional horizontal antenna developed originally for mobile use. Dimensions for operation at 145 MHz are: elements — 19½" 1/8" brass rod; 50Ω coax Q-section RG59, 13½" long. Support details are shown below. From VHF Antenna Handbook by K5JKX, available from 73 for $3.00.



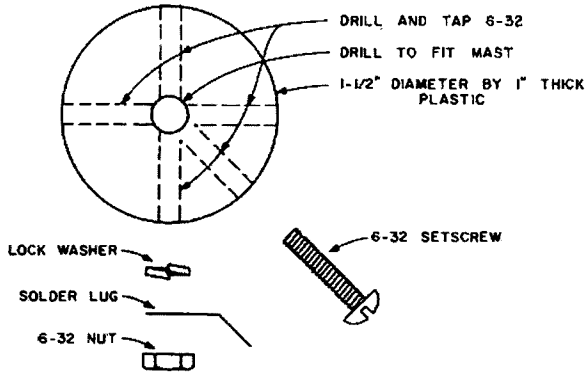
ATTENUATOR

50Ω attenuator circuit for a receiver front end. Use for measuring effectiveness of different antennas by listening to a constant amplitude signal.

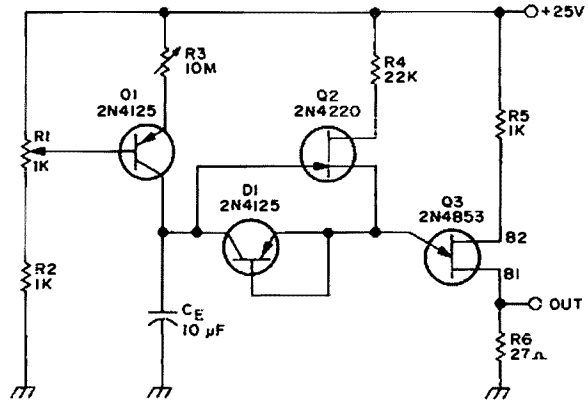
W1OOP



This is a high-frequency antenna switch using diodes. From the Diode Circuits Handbook, edited by WA1CCH, available for $1.00 from 73.



TURNSTILE SUPPORT BLOCK



Long duration FET timer which will give a delay up to 10 hours. Circuit courtesy Motorola Semiconductor Power Circuits Handbook.

An Aural Transmitter Tuning Aid

Florian J. Fox W1KPN
219 Plymouth St.
Stratford CT 06497

A transmitter can be tuned by adjusting the various circuits for maximum power delivered to the antenna feedline. If the standing wave ratio of the antenna system has been adjusted for a reasonably low value, the antenna feedline voltage will, as in the case of an swr bridge, serve as an indicator of relative output power. And relative power can be indicated by means other than visual meter deflection.

With my homebrew SSB rig I use either of two methods to obtain rf output for tuning. In the CW mode I reduce the rf drive by adjusting the carrier injection control to such a level that the final amplifier tubes can not possibly be overheated. In the sideband mode I apply about 20 mV of 1 kHz audio to one of the mike input jacks, having previously set the mike amplifier gain so that the final plate current increases to a safe steady state value when the transmitter is tuned and loaded. Since most rigs do not have two mike input circuits, some additional equipment must be provided if this method of obtaining output rf is to be used.

One big advantage of using the "audio tone" method of generating rf output for tuning an SSB rig is that even when the tuned circuits are far off resonance, the final amplifier plate current will be the normal no signal idling current. This current will increase only when the circuits are tuned and loaded, and if the audio level has been properly restricted, the final amplifier tube, or tubes, can never overheat.

If, as is usually the case, the transmitter has only one mike input jack, it would be undesirable to require the handicapped operator to change the mike amplifier gain setting once it has been adjusted for him. Therefore, the audio oscillator should be provided with an output control so that audio level can be set without disturbing the mike gain control setting. The adjustment of the audio oscillator output is quite simple. Gradually increase its output voltage, when the transmitter has been tuned and the correct mike amplifier gain has been set, until there is a noticeable increase in the final amplifier plate current, a value that will not overheat the tube, or tubes, even if left on for a long time.

The diagram of Fig. 1 shows the tuning concept as a complete system. The circuits needed are the tone oscillator (Fig. 2), a rectifier unit (Fig. 3), and a control box (Fig. 4).

In the case of CW or AM transmitters, since they always produce rf output, the introduction of an audio tone would be useless. Some means should be provided during tuneup for reducing the output rf carrier to a safe level when circuits are off resonance.

Let us now consider the CW method of tuning commercial SSB transmitters. One of the switches will have a position marked TUNE or TUNE-CW and usually a control marked RF GAIN which is used for adjusting the transmitter rf output level. In some cases it is not possible to set the rf gain low enough to prevent the final amplifiers from overheating when the circuits are off resonance. This is why the owner will be cautioned not to tune for longer than about 15 seconds at a time. This could be a real problem for anyone who has to use an

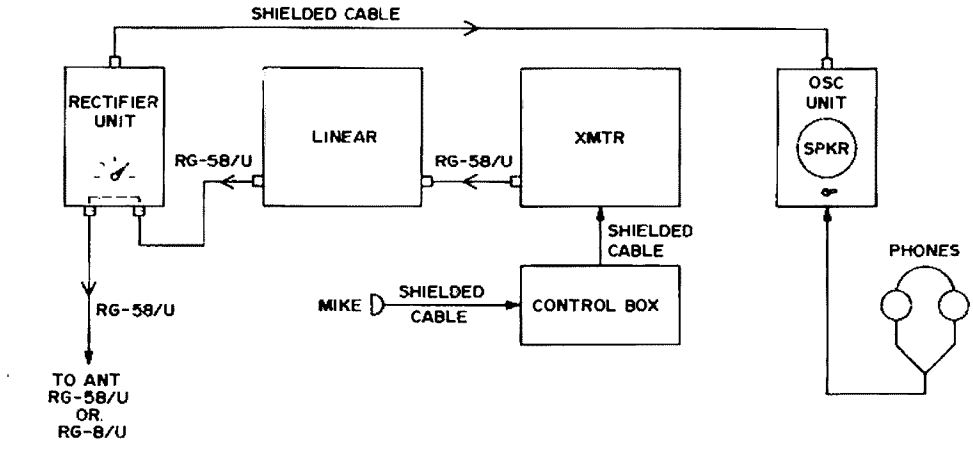


Fig. 1. Block diagram of complete installation.

external tuning aid. It would be well to check this point very carefully before deciding which of the two tuning methods should be used. If there is any chance of damaging the final amplifier tubes, the audio tone method described previously should be used.

This tuning aid has at least two advantages over some of the others that have been published. It is not necessary to make changes or additions to the transmitter, and no external power source is required. Even though it may draw several hundred milliwatts from the coaxial line that feeds the antenna this does not matter because it is disconnected from the feedline when the sensitivity switch is turned off.

Rf voltage in the antenna coaxial feedline is rectified and filtered, producing a dc voltage which is proportional to the rf voltage. This dc voltage, which attains a maximum value when the transmitter is properly tuned and loaded, is applied to a transistor multivibrator oscillator. The output of the oscillator is fed to a headphone jack or it can be switched to a transistor amplifier driving a small loudspeaker. Any variation of the dc supply voltage will change both the frequency and the intensity of the tone produced by the oscillator. In other words, when the rf voltage in the antenna feedline increases, the frequency and intensity of the audible tone will also increase and vice versa.

Originally the tuning aid was enclosed in a single metal box, but in spite of the filtering, there was so much stray rf that the multivibrator would block at high rf input levels. The layout of the parts made it impractical to add shielding partitions, so

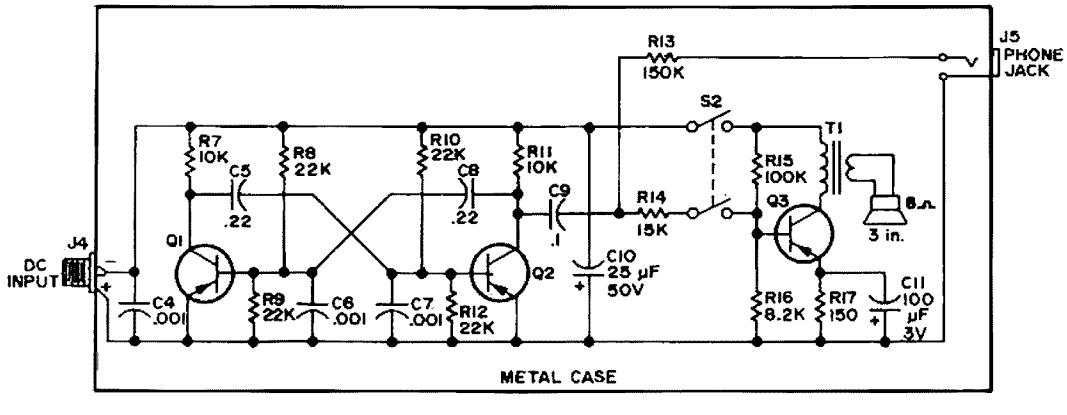
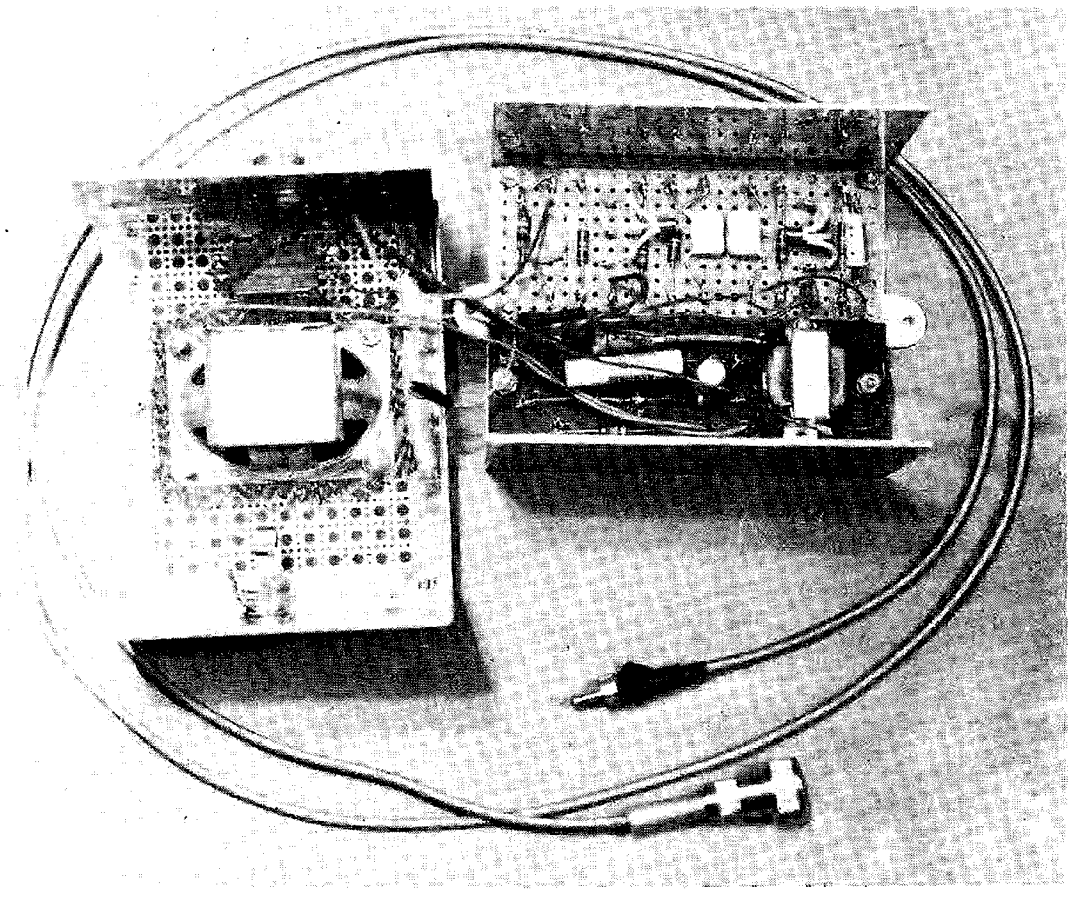


Fig. 2. Oscillator unit. Q_1, Q_2: 2N4354; Q_3: 2N270; resistors ½W size (or smaller): C_4, C_6, C_7: ceramic; rf bypass (value not critical) .001 MFD used; C_5, C_8: .22 MFD paper +/– 20% tol.; C_9: .1 MFD paper +/– 20% tol.; C_{10}: 25 MFD 50V electrolytic (value not critical); C_{11}: 100 MFD 3V electrolytic (value not critical); T_1: Output xfrm pri 1000Ω impedance (approx) sec. 8Ω or 3Ω depending on speaker V.C. – 300mW size, stancor TA43 or similar; S_2: Double pole single throw switch.



The Oscillator

the problem was solved by the use of two separate metal boxes, one for the rectifier unit and one for the oscillator. A single box probably could be used if the two sections are adequately shielded from each other.

Construction

The construction is relatively simple, so a detailed discussion is really not required. And since the circuit diagrams and the photos tell most of the story, I shall confine myself to offering a few suggestions. The miniboxes I used measured 2¼ x 2¼ x 5 in. for the rectifier unit and 3 x 4 x 5 in. for the oscillator, amplifier, and speaker assembly. Anything smaller will result in crowding. Install the antenna feedline connectors close together. For constructing compact assemblies, Bakelite punch boards with insertable terminals are very convenient. After the boards have been cut to size and mounting details worked out, it is wise to make sketches, preferably to scale, to determine the most logical placement of the components for easy wiring. If the final sketch, showing all interconnections, is made on tracing paper, the sketch can be turned over so that the back side of the board can be wired with less chance of error.

The interconnecting cable between the two units must be well shielded against stray rf pickup. Coaxial microphone cable or RG-58/U will be satisfactory. The type of connectors is optional.

The frequency variation of the audible tone will decrease when the sensitivity of the tuning aid is reduced. This is due to the increased series resistance in the rectifier circuit. For best results, hold down the transmitter output as much as possible so that a more sensitive setting (less series resistance) can be used. If there is a linear amplifier, tune the exciter first, then reduce the sensitivity and tune the linear.

The headphones should be of the high impedance type – the higher the better. If more volume is required, reduce the value of series resistor R13, but not below 47 kΩ.

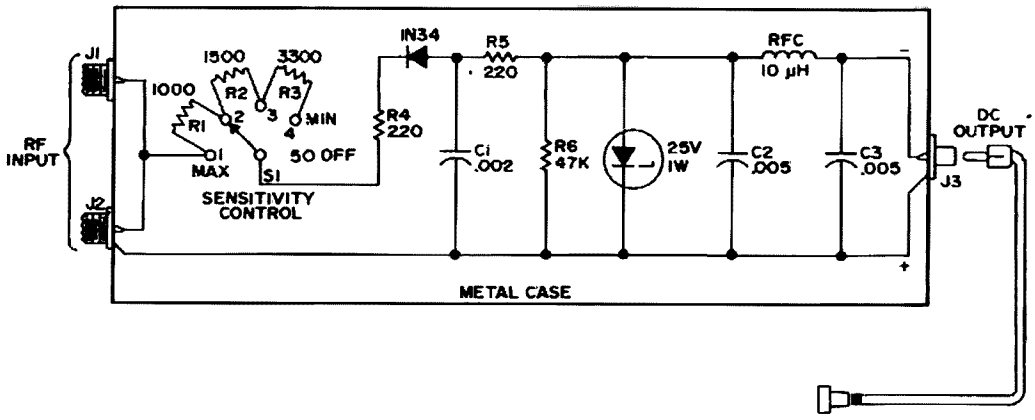


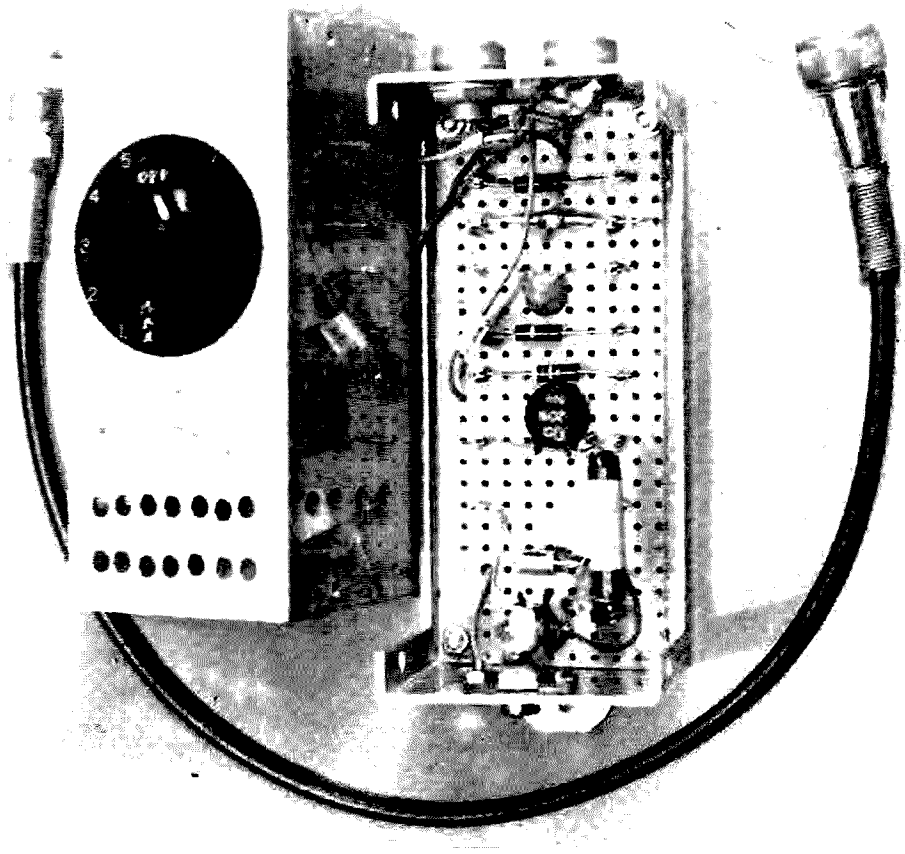
Fig. 3. Rectifier unit

The headphones should be of the high impedance type – the higher the better. If more volume is required, reduce the value of series resistor R13, but not below 47 kΩ.

If more loudspeaker output is required, the 15 kΩ transistor base limiting resistor (R14) can be reduced to about 4.7 kΩ as a limit. If still more output is required, base bias resistor R16 can be increased to around 12 kΩ. But since this will cause the transistor to draw more current, there will be some reduction in the range of the tone variation. It might be better to shop around for a more sensitive loudspeaker.

When using the headphones for tuning, switch off the loudspeaker. This reduces the current required by the unit, which increases the dc voltage variation, and this in turn increases the change in pitch and intensity of the tone.

The speaker switch can be eliminated if you can find a phone jack having two separate normally closed switching circuits



The Rectifier

which will open when the phone plug is inserted.

To install the tuning aid, first select a location for the rectifier unit so that it will be easy for the operator to find the sensitivity control. Remove the antenna feedline from the transmitter output receptacle and connect it to one of the rectifier rf receptacles. (I should have mentioned earlier that these rectifier receptacles should preferably be the same type as used on the transmitter.) Make up a coax jumper cable to go from the transmitter to the other rectifier rf receptacle. Next find a convenient location for the oscillator unit. Make up and install the interconnecting cable between the two units.

If it is desired to tune in the SSB mode by injecting an audio tone into the mike input jack of the transmitter, it will be necessary to make a small audio oscillator having an adjustable output. Its frequency can be between 400 and 1000 Hz and its maximum output need not exceed 50 mV. A compact transistor oscillator, powered by a single penlight battery, can be made up with little effort. The oscillator, a mike jack, a switch, and a shielded output cable should be installed in a small metal box, as shown in Fig. 4, to enable the operator to inject the audio tuning signal by simply throwing a switch. Be sure to procure the same type of jack and plug that is already being used on the microphone and the transmitter.

. . .W1KPN■

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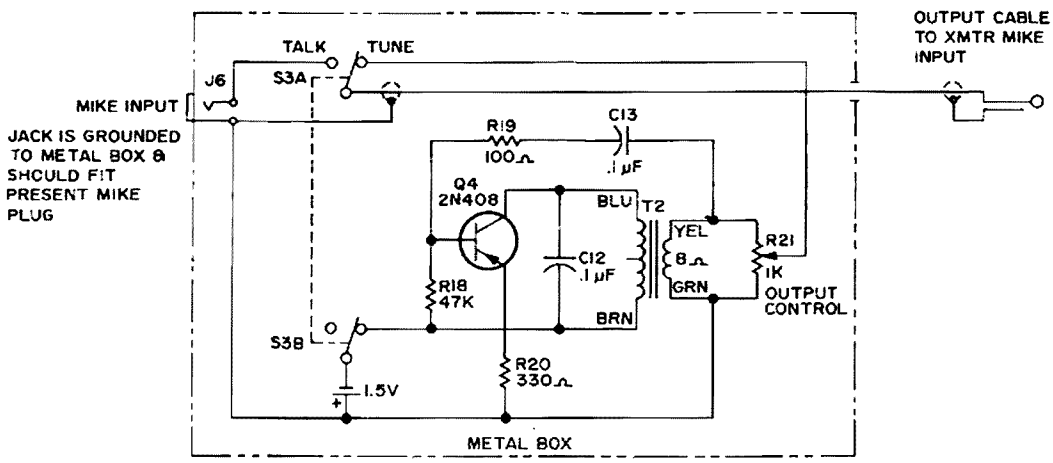


Fig. 4. Mike or audio tone selector box.
Note: Transistor output type AR 169, 200Ω/8Ω, Argonne, Lafayette Radio, or similar. Other types may require different value of tuning cap. C_{12}. If no oscillation, reverse one of the windings.

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...AND MORE!

Enclosed is our 3-year renewal check. Because of our comparatively long term as subscribers (10 years) we feel entitled to a "beef."

Why must your layout-man make the working drawings of schematics and PC board layouts so very tiny as to be impossible to use effectively and yet he wastes much good space (almost half pages) for just the titles of articles. True, the layout is attractive, but the space might better be utilized in making the diagrams and drawings larger and more easily legible – without microscopes.

Bob Cardinali WA2ZXT
Fulton NY

You said it. . .

Having subscribed to your publication for a number of years and enjoying every issue, or I wouldn't buy every three years, I'd like to offer a suggestion that in my opinion is VERY important.

If you still delve in tubes you obtain a manual and as a rule find out what you need to know. We're now in the tens of thousands of solid state devices and more coming up. You'll never get a manual that will cover the info you want.

It is my suggestion that every schematic printed have the "bottom view" showing E/B/C/ etc. Present prints are good on IC's but they sure could make building a lot easier and the originator has this info.

Fred Pursell W1DEM
Mont Vernon NH

The article (The HW-16 on Phone, by Jim Reichler WN2REW) in the August 1972 issue was of great interest to me. There is only one problem, the HW-16 does not have selectable sideband. Since 40 meter phone is on lower sideband and the rig receives upper sideband, even with the filter modification described, you would still be unable to copy 40 meter phone.

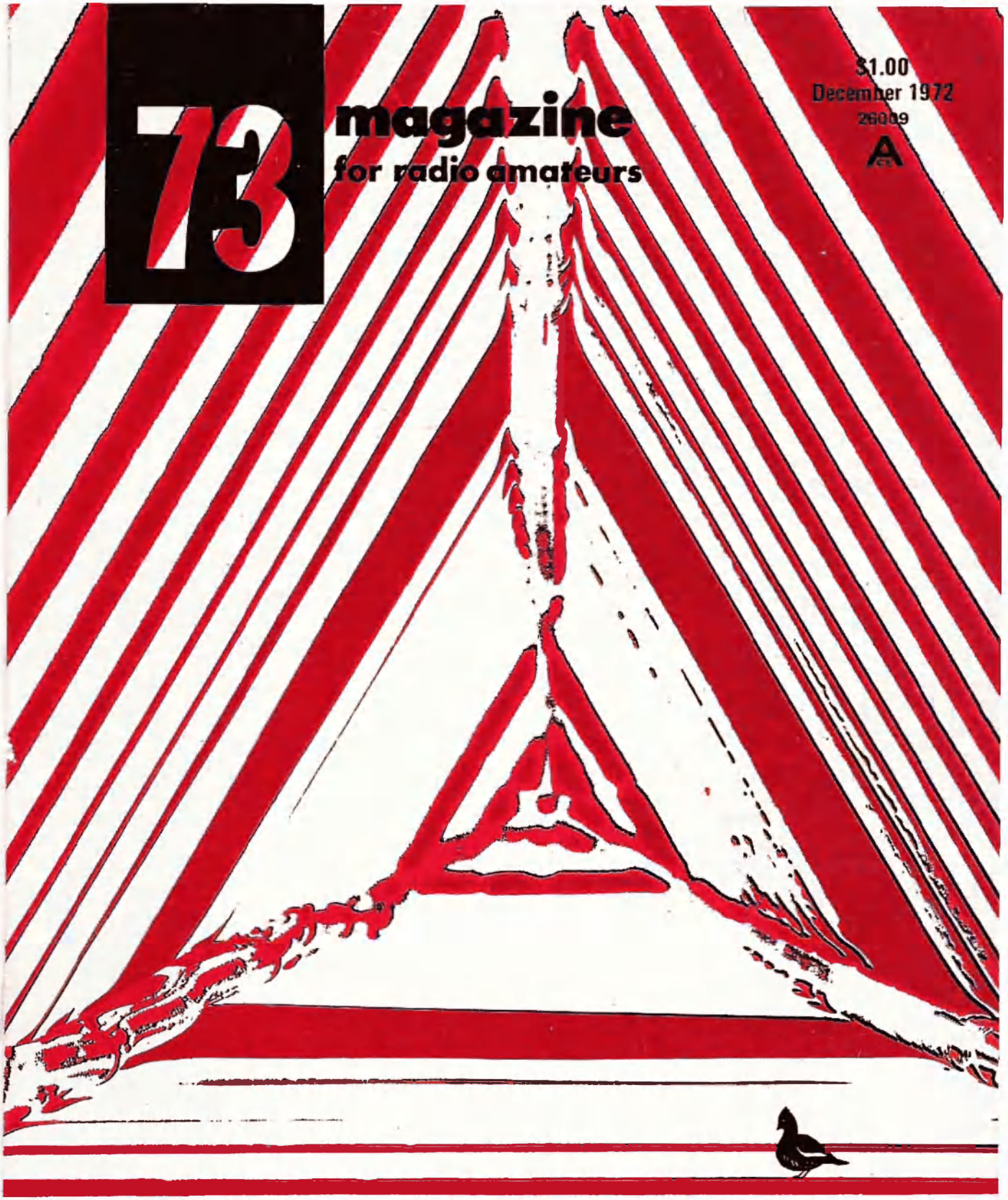
Or did I miss something in the fine print.

E. I. Fullmer WB6MKA
Glendora CA

What you missed was the schematic showing a switch shorting out the crystal filter. Shame! With the filter gone could you really expect the transceiver to retain seletable sideband?

73 magazine
for radio amateurs

$1.00
December 1972
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. . .AND A PARTRIDGE IN A TWENTY METER BEAM!

73 magazine
for radio amateurs
#147 DECEMBER 1972

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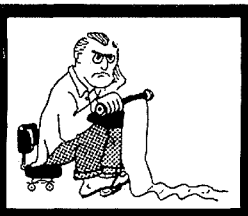
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107 Super CW Filter W6AGX
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112 Novice VFO for 40 Meters W9ZTK
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129 New Novice Regulations ..... FCC
Everybody gets VFO's.
134 2m Preamplifier ..... WØIPB
FET vs MOSFET?
138 3rd Party Regulations ..... FCC
Two and a half pages of No-No's.

COVER: The pattern of covers from September to October to November obviously was heading us to disaster in December. Amateur radio just isn't ready for a nude cover yet, even if we could arrange such a thing. So, thanks to W2ANT, we have a nice picture of a tower which, hopefully, will not lead to too many adulterous thoughts. If you still have such thoughts, then we suggest a visit to your minister.

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You liked the November issue? Something like that could happen again if you don't stop spending money on your hobby and having fun with FM and such. The January issue promises to be another whopper — in case your subscription is running out — or you have a friend who needs a hernia.



NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

OPEN LETTER TO W2TUK

Okay, Harry, you've been president of the League for nine months now and you've had time to get settled into the job.

Your speech at the Hudson Division convention was particularly interesting to me – especially that part about talking with amateurs in other countries from a handy talky via satellite. It would have been gross of me to pop up and ask you right then, in your moment of glory, on what band this great QSO was going to take place. But I sure wanted to.

The main bands that could have been used for this were the amateur 1200, 2300, 3300, and 10,000 MHz bands – all of which were lost for that purpose at Geneva last year. Harry, how are you going to go about getting those bands back again so that mythical contact can take place?

The ITU left us with parts of the low bands – 144–146 MHz – 435 438 MHz, and above 24 GC. There isn't possibly enough room for what you proposed in the 145 and 435 MHz bands, so this sticks it up on 24 GC. Harry, unless you know something I don't, we don't even have a hint of an idea of how to set up anything useful for that band – we don't even have anything in prospect that might someday develop.

My open letter, in lieu of being the gadfly at the ARRL convention, asks you to tell all of us what the ARRL intends to do about getting back the recently lost satellite amateur bands. Since the future you held out in your speech would seem to be possible only by the use of the lost bands, there is an implicit promise of a return of these frequencies.

It is my understanding, in talking with the FCC and many, many others who are intimately involved, that these amateur satellite frequencies have been irrevocably lost – and lost through a lack of preparation for the ITU conference. It comes down to this: either you have some plan for getting back the lost frequencies – or you have some great breakthrough for 24 GC – or you were giving a political speech with nothing to back it up. That would be cruel.

Harry, the pages of 73 and QST are open to you for an answer . . . if you have an answer.

The FCC and ARRL

A quote in a recent issue of CB Magazine is quite illuminating. Richard Everett, attorney for the Amateur and Citizens Division of the FCC was asked: "What is the relation between ARRL and FCC?"

Mr. Everett: *"The ARRL started in 1913 and represents about one-third of the amateurs. They have older members and are very technical minded and file information on rule-making. None of the older members* (of the FCC) *are now members of the ARRL and most of the staff members have resigned from ARRL, especially the ones in my section."*

What can ARRL do to change its image? How can ARRL regain its lost prestige? Though the number of younger amateurs is down, for several obvious reasons, something really should be done to make the ARRL more attractive to them so the average age of the members doesn't continue to climb – it's over 40 now, isn't it?

The FCC and 220 MHz

A recent issue of *Electronics* had a very interesting special report on the EIA and FCC plans for our band. Quote:

"The FCC is on the verge of taking some action on EIA's proposal, confirms Prose Walker, chief of citizens radio operations at the FCC. But any decision in favor of citizens radio is expected to come hand in hand with a requirement that citizens-band transmitters be equipped with automatic identification circuitry."

Well, there it is. Do you still really believe that the EIA is not able to get action by putting pressure on congress? Do you really believe that the 220 band woulc not be perfectly safe if amateur radio had a good Washington lobby? There is no question about this in the mind of anyone who knows politics.

You know, if every amateur spent one half dollar a year on a man in Washington, we could have an expert, complete with a healthy expense account, to stick up for us where it counts the most.

NEW YORK SYMPOSIUM DECEMBER 7TH

The first New York FM Symposium will be held Thursday evening, December 7th, at Lazzeras Cafeteria, Maiden Lane and Pearl Street in downtown Manhattan. This will be hosted by the WAS2SUR repeater in cooperation with 73 Magazine and the Repeater Bulletin.

The symposium will be in three parts – the technical sessions – a rap session for groups with inter-repeater problems – and a frequency coordinating meeting for repeaters interested in changing channels.

The technical symposium will come first with discussions of duplexers, circulators, intermod problems (and their solution), narrowbanding receivers, and such.

The gathering will start at 7:30 for dinner. At 8:30 the regular Symposium will start. At the end of the technical sessions there will be an opportunity for the repeater representatives to get together and try to solve their inter-repeater problems. This will be the first forum provided in New York for this. If it seems worthwhile there will be more.

After the hassle and hock session there will be an opportunity for groups in search of coordination to get together and work out channel problems. The frequency coordinators are under a mandate from the recent repeater association meeting not to hold pairs away from repeater groups that need them and are ready to use them.

Would it be possible for the New York repeater groups to start the nationwide swing to one meg splits with 20 kHz separation? They need the 48 channels of repeaters more than any other part of the country – so who knows?

The Symposium is a joint venture of the WA2SUR repeater and 73 Magazine, by the way. If enough people turn out for this meeting and the opinion is that there should be more, there will be more.

HOW MANY REPEATERS?

A group of repeater owners recently cheered when someone got up at a meeting and said he thought 27 repeaters in any one area was plenty.

The discussion had been on suggestions that repeaters change from the present system of being 30 kHz apart and move to 20 kHz spacing – to-

gether with a 1 MHz split between input and output. This would provide about 48 repeater channels where there are presently only 27, and would also make it far simpler to set up repeaters with sensitive receivers.

How many repeaters are best for any one area? There is no way to tell from the pattern around New York, Chicago or Los Angeles, for all are different, and all leave a lot to be desired.

There are about 25,000 licensed amateurs in and around New York City. Fortunately for the local repeaters only about 1500 of these are active on FM so far. Interest is growing rapidly though and the number is escalating. It is possible that we could see one third to one half of the total getting into the FM act in the next two or three years. The rigs are inexpensive – the repeaters are there – and it's loads of fun.

In New York there is one repeater with over 400 active users – WA2SUR. It is a madhouse – typical of New York. There are a few small repeater groups who discourage non-members from using their channels. There are a few medium sized repeaters – perhaps two hundred users, such as WA2KEC and WA2PDJ. Some of the northern New Jersey repeaters are fairly busy too. There are about twenty two meter repeaters in the area at present.

If 10,000 amateurs go FM in the New York area; 27 repeaters will all sound even worse than WA2SUR. Forty-eight repeaters will make a lot more sense.

And what if the number of amateurs should increase and we should find that we have 20,000 FMers in New York? We will sure be glad for 220 MHz!

TAGGED FEEDLINES

Some repeater operators were a bit piqued at the FCC requirement that remote transmitter feedlines and antennas be tagged. They felt that this would help those who might be bent on mischief to cut the right coaxial or control cables at repeater sites. They were also put out that amateurs should have to do this when business repeaters have no such mandate.

The complainers were quieted by others with the argument that, after all, this isn't a serious problem – and since so many other of the new regulations are so much worse and so much more worthy of battling about, that it would be better to swallow a few minor bruises than to fuss about so many things. By accepting this restriction they felt that the FCC might be more inclined to give on the more bitter pills.

STANDARD ID TONE

An excellent suggestion came up the other day for standardizing the tone used for repeater identification – why not use 1020 Hz for this and build rejection filters into our receivers which will keep us from hearing it unless we want to?

Why 1020 Hz? That's the tone used by aircraft, so the filters are already available in quantity at low cost.

It is nice to find out what repeater you are using when you aren't sure, but once you know it is a bore to have to stop and listen every few minutes as it identifies day in and day out.

FM = FRIENDLINESS MACHINE

Have you ever called in on a repeater when you were visiting a new area only to be met by someone with a crabby disposition? It sure sours the experience. It happens to me every now and then.

If you have a regular user of your repeater who takes delight in putting newcomers down, why not form a posse and try to explain that FM is supposed to be fun and friendship – and that putting people down may be fun for him and build up his faltering ego, but it is a drag for his victims.

You can easily set the stage to dump on virtually every new user of your repeater and have a ball making everyone feel bad. For instance, you can set up a rule that says that no one can call in saying "break." Fine. You'll have loads of customers for a put-down, since virtually every FMer has been trained right from the beginning to put in a "break" before jumping onto the channel.

With a no-break rule you can work out a little passion play for your victims. When the visitor calls in for the first time with a break, you exclaim in exaggerated panic – "breaker on frequency – emergency – come in the breaker with the emergency!" While you may not cure the visitor of being an FMer forever, you will certainly have made him wish he had never tried to talk with your group. And don't think that a condescending explanation is going to smooth things over. There is no way to repair the damage you've done.

Another favored put-down is to break in on a conversation on "your" repeater and frostily announce that this repeater is for emergency use and that rag chewing should be done on other channels. This is the YYQ approach to driving people off FM and it has been used indiscriminately. It is guaranteed to make everyone involved madder than hell – if that is what you want. It is insufferable childishness like this that brings on jamming and profanity.

If you have any really raunchy rules for your repeater – rules which are certain to generate more heat than fun, perhaps it is time to think them over and amend them. FM should be fun – fun for the regulars – fun for the visitors – fun for everyone involved. When new FMers call in, expect them to need some help and be nice about it – make FM fun for them, even if they cause a little aggravation the first time around.

Any comments?

SINGLE FREQUENCY REPEATERS

Motorola has a license (KQ2XQU/ Ft. Lauderdale FL) to experiment with a single frequency repeater on 557 MHz. We assume that this may be done with a time splitting arrangement via a chopper circuit. If anyone has any details on how this might be done the readers of 73 will certainly be interested.

DXers ARISE!

How are your QSL bureaus doing for you? 73 has received zero letters of complaint, so it is assumed that everything is going smoothly. Funny how no one notices the bureaus much when they work – but when something goes wrong – wow!

The W2NSD/1 cards have been coming through the Northern New Jersey DX Association QSL Bureau without a hitch for quite a few years now. Surely no other bureau can be doing better than this group. Huzza for the dedicated DXers who sort through thousands upon thousands of cards every month – with no pay – and with darned little praise.

If you have worked any DX you undoubtedly have some cards gathering dust in the files of your local QSL bureau. They're listed in QST, so the next time you work a League member, you can ask him to look it up for you. The bureaus normally keep cards for three years before throwing them out. And they really hate filling trash cans with cards from JT, CR9 and other really rare ones – but out they go! If you haven't an envelope with your bureau, better get on it.

What's With RACES?

Non-hams using our precious Fm repeaters? You bet! Apparently I need some more information on just exactly how RACES is set up. I was under the mistaken impression that this was supposed to be an emergency use of amateur bands and that licensed radio amateurs were supposed to be organized in nets – including FM repeater operation.

But apparently in some areas of the country the local RACES director has

set up non-amateurs with equipment to work through the repeater using the repeater call and a unit number instead of a regular ham call.

Fellows, when you run up against non-licensed users of our bands please make an inquiry and send all the details you can to *73*. There may be some emergencies where none of us would have any objection to non-ham RACES personnel using our bands, but I think most of us would like to encourage regular users to get their ham licenses.

WINDJAMMER OPPORTUNITY

There is an interesting opportunity for one or two amateurs with marine knowledge and experience to get a half fare rate on the Yankee Trader around-the-world cruise. The regular rate is $18 per day - but someone who could help to operate and service the loran, radar, and radio gear could have the adventure of a lifetime for about $9 a day. The gangplank goes up soon, so get cracking.

Can the Amateur Industry Organize?

There would seem to be some persuasive reasons for the manufacturers of amateur equipment to get together and work out some solutions to the more pressing amateur radio problems - like how to get more hams – how to keep the FCC from taking away the ham bands – how to keep the FCC from cutting back, bit by bit, on amateur privileges.

The industry has attempted to organize in the past, only to be thwarted by the ARRL, which may not do very much to help the hobby grow, but is ever alert to any possible threat to their power.

An investment of one percent of the gross receipts for sales of amateur equipment would provide a fund which could be used to encourage the growth of the hobby. How much would it really cost to have one retired ham, knowledgeable in public relations, who could organize the better ham writers to provide articles and stories about the hobby and sell them to the top magazines? Almost every major magazine would love to have a good ham radio article now and then – unfortunately there is no one (or group) to organize this, so we get no exposure and our hobby is confused with citizens band.

With a little promotion the growth rate of amateur radio would be right back up there where it was in the 50's – maybe better. This would bring new life to our clubs – more enthusiastic operators to fill in the empty bands – and maybe even more QRM on Sunday afternoons, if that is possible. One million amateurs would not seriously strain the spectrum we have available, but it could bring about a great deal more respect from the FCC and perhaps save us from the devastating rule changes.

MENSA NET

More and more amateurs have been joining Mensa and the result is a regular net. It meets on 14.280 at 1800 GMT on Saturdays according to WA6KGP. Amateurs interested in joining Mensa can drop a note to 73 Magazine, Peterborough NH 03458 and get a little brochure telling about it. The only qualification is an IQ of above 152.

MORE COLUMNISTS

There are two more aspects of amateur radio that we would like to cover regularly in the 73 newspages – contests and certificates. It is possible that we might be receptive if someone who was seriously into these things offered to keep the 73 readership informed.

We might even be able to add some pecuniary interest to your amateur radio hobby.

If you have better than average connections on keeping up with certificates and awards, and are interested in preparing capsule facts on them for the 73 newspages, drop a line to us.

Ditto contests. Readers would like to know what contests are being run, when and enough data to get started in them or send for full rules. We do want to leave CQ as the source for exhaustive details on contests and just bring a synopsis to 73. Anyone with good bona fides interested?

NOVICES UPTIGHT

One of the most persistent complaints heard at the Hudson ARRL Convention was a chorus of gripes from Novices about the latest CQ action. It seems that CQ has been sending Novices a note telling them that they will receive a six month free subscription to the magazine. Then, after an issue or two, along comes a note saying that this subscription is an impossible burden and they really should foot their share of the cost and how would they like a two year subscription for $6.00?

ARTICLES NEEDED

Quads. Interest is high in quads and it would be nice if we could run a special issue full of quad articles. How about it you designers and builders?

Matching of VHF beams could use some coverage too – any "experts" out there who own a typewriter? And please write it so the average VHFer can use the material – forget the Smith Charts and gobbledegook and keep it to practical how-to-do-it instructions.

Slow scan – almost anything that hasn't been printed on this should be – we can use a whole bunch of articles.

FM – although we are not packing every issue with FM articles, we still want to keep ahead of all the other ham magazines. Circulators – isolators – solutions to intermod – to desensing, and, like slow scan – anything that hasn't already been published should be. We'll run articles, books, just circuits, whatever you have.

Antennas – if you have any new ideas they should be written up and we hope you'll give 73 first choice.

Novice VFO's – let's go on this one!

Several readers have asked that we try to publish more articles for the beginners, keeping in mind that there are readers who are not only non-engineers, but who are still not really sure about how a volt-ohmmeter works. Some of you readers who have been teaching the General license exam might make a note of the points that need to be covered and provide helpful articles on them. We could also use some simpler construction projects for the amateur who has always wanted to build, but who has been afraid to get started.

Wayne

SSTV SCENE

Dave Ingram K4TWJ
Rte. 11, Box 499, Eastwood Vil. 50N
Birmingham AL 35210

An item of growing interest in slow scan conversations is binary, or computer types of, storage devices. Although present costs are considered high, this should drop in the near future as manufacturing methods advance. MOS Storage, or "memory" units can be used to store a slow scan picture in the form of "bits" of sync and video information. Naturally, this can be "programmed" or "replayed" at will. Quite a group of possibilities, eh? The present cost is approximately 1 (one) cent per "bit" and a typical slow scan picture has around 12,000 "bits" of information, so immediately there's a cost of $120. However, watch this interesting market. A substantial price reduction will no doubt open new slow scan horizons, such as



ZS3B's African cartoon as received by WB6LSX – good detail for such DX.

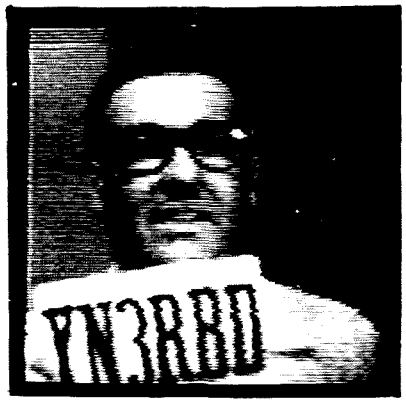
all electronic I.D. units, or slow scan stored and fast scan reproduced pictures (which could be viewed on your regular TV). And, if this can be accomplished with one frame, it can be accomplished with three – one red, one blue and one green, which again could be viewed on your regular color TV.



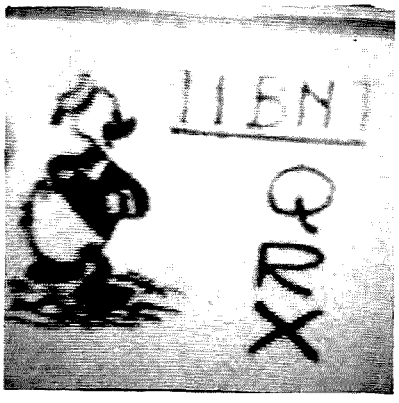
W1VRK as seen on the slow scan monitor of ON4DN.

Mohammed, 9K2AM, has been rather active on slow scan lately. If you would like to work him try watching 14.230 kHz around 1200 GMT. This is also a good time to watch for ET3DS and ET3KH, two more newcomers to slow scan.

I understand Mike Tallent is developing a direct sampling circuit for fast scan cameras, that will require no internal connection to the camera. Just connect it to the fast scan output and it gives out with full slow scan. Possibly in 1973 this will become available on printed circuit boards, as his monitor circuit is at present. I can see the results now – slow scanners clamoring to TV stations, sampling rigs in hand, and slapping them on the TV station's switcher output. Then recording a pile of programs with full zoom pictures, studio lighting, special effects – gad, what a ball!



YN3RBD transmitted this slow scan picture to K4TWJ on 20 meters – very little QRM!



IIBNT transmitted this picture to ON4DN on 20 meters – without QRM.

Word is just in from Franco, I1LCF that the third worldwide Slow Scan Contest, sponsored by *CQ Elettronica* of Italy, will be held Saturday, February 10 and Sunday, February 18, 1973. Full rules will appear soon; however no radical changes from last year's contest are expected . . . should be a real blast.

As slow scan Christmas cards whiz to and fro, may I take this opportunity to wish you a very Merry Christmas

73 . . . Dave, K4TWJ

REPEATER ASSN LAYS BIG EGG

It seems likely that Bob Waters and Gordon Pugh bit off more than they could chew when they tried to expand Gordon's Northeast FM Repeater Association to include everything from Maine to North Carolina and out west to Ohio. It didn't jell.

There is an obvious need for associations of local repeaters, but once you get outside of a couple of hundred miles the repeater groups have no need to get toegther – and they won't.

It seems as if what is really needed is repeater councils for areas of the country – and then perhaps a yearly meeting of all of the repeater councils from all over the country.

When the Northeast Repeater Association , Inc., had its annual meeting in Pennsylvania recently only 33 groups had joined out of about 215 in the association area. And when you consider that most of those had joined on a temporary basis, just to see if the idea was worthwhile, the support for the association seems too slim for survival.

As a result of the fiasco, repeater groups in New England are working up a repeater council for the greater Boston area and a similar plan is afoot in New York City.

NORTHEAST LAYS BOMB

The October 7th meeting of the Northeast Repeater Association drew only a handful of repeater delegates, despite its attempts to attract groups from Maine to North Carolina and out to Ohio. The count was 85 present and only 36 out of the approximately 200 repeater groups in the area signed on even temporarily.

There were several reasons why the interest of repeater groups was so low. One of the most important was that no one could think of any substantial reason for the Association to exist. There were no known benefits to anyone to join or come to meetings.

Another major problem was the size of the area covered by the Association. When an organization stretches out so far that it takes the delegates from each end about six hours to drive to a meeting – and six hours back, there has to be some powerful reason for the organization. There is no reason for this organization other than to have officers, dues and by-laws.

Thirdly, the early history of the Association was unsettling. Many of the repeater groups felt that much of the business was done under the table – and their confidence was not improved at the October meeting when the officers slipped a great big one by everyone, apparently laughing up their sleeves at their cleverness.

Readers who are interested in the exhausting details of the sneaky Association doings would do well to

subscribe to the Repeater Bulletin, wherein these shenanigans have been covered at length.

The big one slipped by everyone in October had to do with the Association newsletter. This started out as a typewritten letter for the first two "issues," so the delegates had no way of knowing that anything was afoot when they okayed the sale of copies to anyone wishing to subscribe – it was mentioned that a few people had asked about this. Nor were they alerted when it was asked if anyone had any objection if some advertising was accepted to help defray the cost of publication – who could object to that – every club bulletin has a few ads – right?

Would you expect that these innocent agreements would get you into the publishing business in a big and expensive way? The delegates from the 73 Radio Club sat back and stifled broad smiles as they watched this one slip by. And there in the back of the room was a manufacturer who reportedly had the remaining bones of defunct RPT . . . in his pocket, desperately looking for someone to publish. The post office takes a very black view of manufacturers who try to publish magazines, the last we heard, so some third party is needed.

The way of the splinter ham magazine is a rough one and we wish luck, of sorts, to the Association in their new role.

NEW STANDARD REPEATER

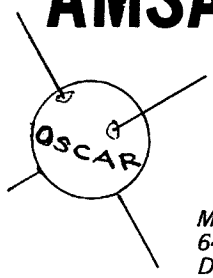
One of the first production models of the new Standard Communications repeaters was set up at the WA1KGO (73 Radio Club) repeater site in lower New Hampshire. Even though the antenna setup was far below the minimum recommended separation, the repeater worked and worked well. What a pleasure to have a repeater you can take out of a box, connect to twelve volts, plug into a couple antennas, and turn on!

When it first arrived and was unwrapped, it was set up in the 73 offices and plugged in, just to see. The result was an instant repeater which covered about ten to fifteen miles – just perfect for any town or small city. The 73 HQ is about 200 feet below the average terrain, as defined by the FCC.

Up on the mountain the Standard repeater was suddenly one of the big boys, permitting amateurs in Boston (80 miles or more) to talk with FMers just about anywhere in that radius. With the proper antenna spacing the rig would work even better and the coverage would probably go out to 100 miles.

The crew at Standard is certainly to be congratulated on putting out a fine little repeater.

AMSAT NEWS



Mike Frye WB8LBP
640 Dauville Dr.
Dayton OH 45429

OSCAR 6 was launched on schedule at exactly 1719 GMT on Sunday, October 15th. THe launch went beautifully and there were few problems. I have picked up the satellite in my area but have so far been unable to transmit through it, possibly because of area conditions.

Monitor CODESTORE on board Oscar 6 and the AMSAT Nets for orbital information. There is also a number you can call in Washington for up to date information (daily between 2300–1200 GMT (202) 386-4483).

AMSAT has a standard reporting form that is available. The form is self explanatory and deals with signal reports, times, and atmospheric conditions. One can be obtained by writing to AMSAT directly, or sending a SASE to me and I will send you a couple of copies.

AMSAT, P.O. Box 27, Washington D.C. 20044.

AMSAT NETS

On Sundays of every week

1200–1300 GMT on 14.280 MHz SSB

1300–1400 GMT on 21.280 MHz SSB

1800–1900 GMT on 14.280 MHz SSB

1900–2000 GMT on 21.280 MHz SSB

On Mondays at 0100 GMT on 1855 MHz SSB

FIGURING ORBIT TIMES

Period of orbit – 115.138 Minutes

Change per orbit – Add 28.81 Degrees

Inclination – 107.76 Degrees

Beacon frequency – 29.45 MHz

Orbit No.	Longitude West	Time GMT*
1	323.97	1824.99
2	352.79	2020.24
3	021.60	2215.48
4	050.41	0010.42
5	079.22	0205.96

*Depends on launch time; add or subtract minutes from 1719 GMT.

OPERATING PROCEDURE

After calculating where the satellite is, the following is a recommended method of using the two-to-ten meter repeater.

When the satellite comes into range begin listening for the morse code beacon on 29.45 MHz. The beacon sends the message HI . . . . .

After you have located the beacon on 29.45 MHz, tune up the band and begin looking for the signals from the repeater in the 29.45 MHz to 29.55 MHz range.

Before beginning to transmit, a few simple steps should be taken to insure that you do not overload the repeater. If you are going to use high power (greater than 80–100 watts erp) transmit your signal a little off the normal repeater passband.

This will ensure that you do not overload the repeater and cause the agc to go into action. It will also make sure you are not using more of the repeater than your share and you won't blank out weak stations that might be trying to call you.

When transmitting, start by sending a test signal, preferably a string of dots, on this frequency (f_2). Listen for your own signal retransmitted from the satellite on the corresponding ten meter frequency (f_{10}) found from this formula.

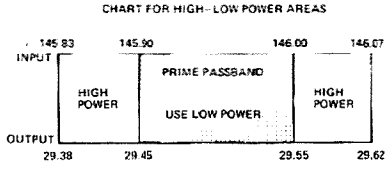
$f_{10m} = f_{2m} - 116.45$ MHz $\pm f_{Doppler}$

where $f_{Doppler}$ = +4.5 kHz near beginning of pass

= 0 kHz at middle of pass

= (–) 4.5 kHz near end of pass.

For example a signal transmitted on 145.92 MHz will be retransmitted on 29.47 MHz ± Doppler. This is where you signal will be, if you can hear it, others can too.



OSCAR 6 FACT SHEET

Input frequency range – 145.90 to 145.00 MHz

Output frequency range – 29.45 to 29.55 MHz

Passband is not inverting, in other words upper sideband remains upper sideband and vice versa.

Beacon frequency – 29.45 MHz

Beacon modulation – A-1

Repeater bandwidth – 100 kHz flat

120 kHz at 3-dB down points

150 kHz at 6-dB down points

240 kHz at 10-dB down points

Operating modes SSB and CW are recommended. AM, RTTY and SSTV can be used with less efficiency. FM is not recommended.

Repeater power output – 1 to 1.3 watts CW into half wave dipole

Input sensitivity – Approximately

100 dBm (2 mV/m) for full output. Ground power required – 80–100 watts of effective radiated power produces full output from repeater at maximum range of 2000 miles.
Intermodulation – 20 dB down
AGC
Up to 26 dB gain reduction
0.1 sec. attack time
2.2 sec. release time (highest efficiency with SSB).
Receiving antenna – Dipole can be used but beam is preferable.

WB8LBP

DETROIT ARA ON 220

At the September Board meeting of the Detroit ARA, a proposal was adopted to sponsor a "DARA 22 MHz System" which would include funding to members for constructing transceivers to operate into a repeater. Personal construction was encouraged as part of our educational training, due to the lack of commercial transceivers for this band. The FCC has now released Docket 18803 which allocates the 222-225 part of this band for repeater use. Now it is up to the clubs to follow through and make use of this excellent band which is partically QRM free. This is another area for an excellent autopatch from your car, or a portable system for emergency operations. At least 26 members signed up to work on the project at the last meeting.

73 CRUISE

Plans are firming up for a 73 sponsored Windjammer cruise to leave Antigua on the first of May 1973 for eleven days of sailing and visiting rare Caribbean countries.

Some of the more interesting islands on the route are Dominica, a remote and lush jungle of an island, complete with Caribe indians, a visit to the very French Martinique and a get together with some of the FM7 boys you'd like to work. Your wife will enjoy the shopping and the beauty of the spectacular cliffs and coves along the coast. Captain Bligh's "Breadfruit Isle," St. Vincent, still unknown to the tourists. The beautiful beaches of Grenada – skindiving – fishing. The sandy beaches of Carriacou. Venezuela – will we be able to keep the YV5's from capsizing the boat? – St. Lucia, a combination of British and French – and, don't forget Antigua and the steel drum bands that are world famous.

Will there be a rig set up on the ship? What a foolish question! You'll have the chance to make half the world eat its heart out as you DX. Of course you may prefer to spend your time lying on the deck, soaking up the Caribbean sun – or you may prefer fishing – or skin diving – or visits to islands – to fantastic beaches – or taking photographs for the radio club back home – or you may want to devote your time to eating the great meals.

Whatever you like, you'll be in the company of enthusiastic amateurs where you can swap DX lies and antenna put-downs. After having run two very successful ham tours, we can tell you that traveling with hams is real fun – a whole lot more fun than just any group.

The ship leaves Antigua on May First and returns on May 12th. The weather is guaranteed to be perfect.

The cost, per person, starts at only $290 for the whole trip, including just about everything except the booze. Special cabins are a bit higher – $365, and go up to $410 for the most lavish cabins. First come first served on accomodations.

The yacht is not to be sneezed at, by the way. We will be sailing on the Fantome, formerly Onassis' yacht, which is 262' long – almost as long as a football field. This yacht was built for the Duke of Westminister as a private floating palace. Onassis planned to give the yacht to Prince Ranier and Princess Grace, but it was never delivered. It has private baths, air conditioning and red carpets. There is room for fifty or more on the cruise, which may seem like enough except that almost twenty have alread signed up and the word has hardly been leaked out as yet.

Drop a line to 73, Peterborough, NH 03458 if you want to join this happy group. It will be informal – barefoot – and fun. And do bring the wife. If she has trouble with the sea she should know that this great big boat is very steady and seasickness is virtually unknown on her. If the wife won't go, maybe you have a secretary or good friend who loves the sun and the sea?

MARS

Harry Simpson A4SCF
73 Magazine
Peterborough NH 03458

Harry Simpson A4SCF

People wonder why we keep our ham magazines for years after we receive them. I usually explain that my interests are in a certain sector of electronics at any given time, and an article that was only of passing interest in November, 1970 might be of supreme importance in November, 1975!

This MARS Column is a distinct example – the first effort, printed many months ago, gave an address for Navy MARS that was incorrect, although it was the address printed on the MARS brochure. The same article used my home address, rather than the 73 address in Peterborough. I am still receiving mail addressed to my home, complaining about the inability to contact Navy MARS at the address given! Come to think about it – you are not alone! In spite of numerous phone calls and letters asking for information, and asking that I be placed on the mailing list for Navy MARS publications, I have yet to receive a single word from them! *Quien sabe?* Perhaps that organization is only a figment of some overworked imagination!

Obviously I am being facetious. There *is* a Navy-Marine Corps MARS and it is quite active, its members numbering into the thousands of public-spirited amateurs. It's just that you have to be a member of Navy MARS in order to find out how to join! For the record, here's the latest address I have: *Chief, Navy-Marine Corps MARS, 4401 Massachusetts Ave., N.W., Washington DC 20390, Mail Stop 394.*

To cut down on the workload, let's do it this way – if you would like to join *Army MARS*, and would like further information on this splendid program, write me in care of 73 Magazine. I will answer your questions, and also pass along the name and address of an Army MARS member in *your* area who can tell you about the program on a local basis. On the other hand, if you would prefer another service, I suggest that you contact them directly, since I have already told you all I know about them. For several months I have been sending out an average of two hundred letters per month in answer to your queries, and at my own expense. To the ten hams who included SASE's with their queries – I am grateful.

This article is being written while on vacation in the southeast – at the moment, Pensacola – and the most amazing thing that occurs on each vacation, is the realization of the broadening scope of 2 meter communications! In the Third U.S. Army MARS area – North and South Carolina, Georgia, Florida, Tennessee, Alabama and Mississippi – there are over *thirty* MARS repeaters, covering most of the very large area! Several other machines are being readied, and pretty soon you'll have to turn off your transceiver to get away from it all!

A word about prefixes: In Third Army area, W is changed to A, K becomes AA, WA is changed to AD, WN and WB are changed to AL. KP4 and KV4 are *both* changed to AE6 (a paradox that might cause some trouble in the event we sign up both KP4AA and KV4AA . . . they would *both* be assigned the call AE6AA!).

Listen any evening on 4001.5, 4015, 4020, 4025, 4030 and 4035 kHz for our typical operations, and then write for more details. We'd like to have you!

See you next month . . . *A4SCF*



DEEG DIGS NEW HAMPSHIRE

Here is Fred Deeg K6AEH, the sales manager of Standard Communications, making a nice DX repeater contact from the top of Pack Monadnock, the site of the WA1KGO repeater. The antenna on the side of the fire tower behind Fred is the receiving antenna for KGO – height 2300 feet above sea level and radio horizon about one hundred miles. It took one of the worst muggy spells in the history of New Hampshire to get Fred on his way back to "sunny" California.

The new Standard repeater is now set up in the same tower and providing fine FM coverage for a good deal of New England.

And what hand unit is Fred using? A Standard, of course!

73 FILES PETITIONS

There have been six petitions filed by 73 on the new repeater regulations so far – with more in the offing. The new rules have some advantages, to be sure, but the disadvantages seem to overshadow them and 73 has filed with the FCC on the sharpest points of objection.

For instance there is the matter of the prohibition of cross banding of repeaters. There has been no example known to the 73 staff of any serious problems arising from this practice. To the contrary, those few repeaters which have this function have been most popular and have provided a valuable service interconnecting the groups using one band with those using another.

The FCC, the Amateur Division of the FCC and the Commissioners need to be reminded that this is amateur radio – it is a hobby – and that we need latitude to experiment and develop systems of communications. The Commission deals 99% or more of the time with commercial users and perhaps this has biased their judgment for the new regulations seem more fitted to commercial operations than amateur.

If the Commission would restrain itself and provide regulations only when there is a clearly demonstrated need for them – only when amateurs have demonstrated that they are unable to manage their own affairs, then the growth and technical development of the hobby could move forward relatively unimpeded. The fact is that even though we had no regulations covering repeaters, we had no real need for them. One would wish that the Commission would ignore the requests of amateurs who need the security blanket of exact and detailed rules.

Repeaters have shown, more than any other amateur groups, that they are able to regulate themselves. The cooperation has been epochal. Interference has been kept to a minimum – intergroup hassles have been ironed out just about everywhere – jamming has been coped with – frequencies have been coordinated – standards have been agreed upon and all but a few really hardheaded repeater groups have fallen into line.

In the face of this truly remarkable progres, the FCC repeater rules are an insensitive slap in the face. We have little for which to thank the few amateurs who initiated this action several years ago. Perhaps it is only fitting that Gordon Pugh W2GHR is one of the hardest hit by the new regs.



1973 Friendly Firebird QSO Party

Date: From January 6, 1973 at 1800 GMT to January 7, 1973 at 1800 GMT.

Group: General Motor's World Wide Employees and Retirees.

Call: "CQ Firebird" on phone or "CQ FB" on CW.

Exhange: Signal report, State (or country) and Handle plus Firebird members will send a four-digit number corresponding to his General Motors Operating Unit (i.e., "0101" for AC Spark Plug Division). Send SASE to W9MDW for cross reference sheet.

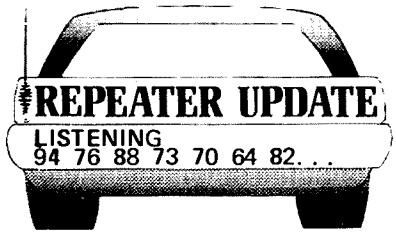
Scoring: One point per QSO. Work each station only once regardless of frequency.

Multiplier: Number of different operating unit numbers.

Total Score: Total QSO points times total operating unit numbers.

Frequency: Any frequency, but suggest 3.985, 7.285, 14.285, 21.385, 28.785, 50.520, 145.440 MHz and near bottom of each novice band.

Logs: Send to Dick McClain W9MDW, 1613 Cherry Hill Lane, Kokoma, Indiana, 46901 by February 15, 1973.



CT	W1WHZ	Norwalk	147.99–147.39
IL	WB9INL	Hinsdale	07–67
IL	WB9AET	Wstrn Springs	224.8–222.8
MA	K1JMR		Delete
MA	W1MTV	Westfield	10–70
MA	WA1KHC	Pelham	13–73
MA	W1IFL	Foxboro	31–91
MA	WA1LUT		Delete
MA	W1HEB	Boston	147.96–147.36
NH	K1MNS	Derry	53.58–52.52.98
NJ	W2QW	Martinsville	025–625*
NJ	WB2LPV	Oakland	10–70
NY	WA2UYJ		Delete
NY	WA2MBT	Plattsburgh	22–82
NY	WA2KEC/2	Manhattan	40–147.00
NY	WA2ZWP	Brooklyn	205–805*
NY	WB2ZIO	Staten Island	145.935–146.535*
NY	WA1UYJ		Delete
NY	WA2NVT	Plattsburgh	22–82
NY	WA2PDJ	Bellmore	25–85
NY	W2OQI	Brookhaven	147.12–146.82
			58–82
NY	WA2KSB	Wading River	10–70
NY	WA2QNN		Delete
OH	K8ALB	Toledo	Delete
OH	WB8CRL		Delete
OH	WB8CSV	Springfield	13–73
PA	WA3QCE	Pittsburgh	28–88
PA	WA3BJS	Pittsburgh	16–76
PA	WA3BNO	Pittsburgh	37–97

*Looking for a 147 pair.

UPDATES REQUESTED

The next printing of the full list of all repeaters in the world is scheduled for the April issue of 73. It would be appreciated if every repeater group would send in at least a card giving all possible repeater information for your area – including the frequencies of your repeater, the town it is located in, a mailing address for correspondence – a list of all other repeaters in your area – calls – towns of location and channels used. It is much easier to make up a list with too much information than too little.

The FM Repeater Atlas is updated three times a year, so it is important that all changes in repeater channels, calls, or location be reported as soon as they are known. Thousands of amateurs depend upon this atlas to help them to keep in contact with repeaters as they travel – don't disappoint them by letting your listing or that for your area get behind.

SAROC

Disappointment

The FM program at Saroc last year left a lot to be desired so I offered to set up an FM Symposium for this convention that would hopefully be better. Along about the time I had things nearly organized, I got a call from Leonard Norman, the chap who runs the convention – someone had threatened not to exhibit if I ran the FM program – it was all off, he would set up his own FM program.

Was it an advertiser who has been banned from the pages of 73 or a fellow publisher in a panic after seeing the November 73? Unless I have some very secret enemies, I can only think of about three possible people who could have pulled that one.

Whoever it was saved me a lot of time and expense. They also cut my enthusiasm for Saroc by about 98%. If it weren't for the chance to sit and talk with a whole lot of good old friends, I would pass it up. Las Vegas is a gaudy, expensive, plastic bore. Sour grapes – right?

Wayne

50 MHz BAND

Bill Turner WAØABI
5 Chestnut Court
St. Peters MO 63376

K8LEE reports an opening to South America on the 19th of September around 2240 Z. A few minutes earlier, weak signals had been heard from Florida (W4GDS) and these continued intermittently during the approximately one hour the band was open. Wayne, WA8PEB and K4JBV worked LU8AHW (CW and SSB), LU3EX and HK3OK (AM) during this period. Tapes played over the telephone confirm the excellent signals received. There was apparently no connection between the two openings. Florida was weak E while South America was rather strong TE, peaking at times to S9. Wayne reports these signals were also heard in Indiana but were rather faint there. Did anyone else manage to work this opening?

Jim, K7ZFG/6, passes along some further information relating to the carrier null instability sometimes experienced with the Swan 250. "In mine, the carrier balanced with the start of transmission, drifting to near full carrier after about a minute. Eventually the control was so far off center that the carrier couldn't be balanced even at the start of transmission. My solution was to replace R1305 and R1309 with 47K, 1 watt resistors and replace R1306 and R1310 with 100K, 1 watt resistors. After this, the carrier balanced in the center as it did when new, and hasn't caused trouble since . . . it might be advisable to use 2 watt units for additional stability and also replace R1307 with a 1 watt resistor."

I might add that it is not uncommon to find a new 7360 which will not balance with the original resistors; often it is inconvenient or impossible to try several tubes in order to find one which will work properly. The solution is to reduce the fixed resistance on one side of the circuit and increase it a like amount on the opposite side. The unbalance caused will correct the unbalance within the tube. Decrease the resistance on the side to which the null pot must be turned to come close to a null. The amount of resistance change is determined by the unbalance in the tube. Try 20 0/0 for starters. This change may also be used to temporarily cure the problem in a rig with an old tube which has become unbalanced with age. This will allow you to stay on the air while a new tube is being obtained.

K5MTK writes from Fort Worth to say that he has found the problem in his Globe Hi-Bander and will shortly be back on the air – this time with a new 5 element beam. Elmer also passes along the information that the Arlington Radio Club meets Monday evening at 2000 local on 50.8 and the Tarrant County Six Meter Emergency Net meets every night at 2100 on 50.7.

Lowell, WB4WNV, asks "Do you know of any net type operations on 6 meters in the north Georgia area? How about even any individual stations that operate regularly?" I don't know of any active nets or individuals in your area. Georgia has always been rare in this area either because of the distance or lack of activity. I have always assumed it to be the latter. Perhaps one of our readers will offer your group assistance in getting on the air, and let us know about the local activity, too.

Peter, WA6HXM, writes to say that he and WB6ECD have both worked and confirmed contacts with VE1ASJ. There seems to have been some confusion about the comment in the

October column to the effect that Andy had not made a California contact. This comment was in reference to the July 18-19 DXpedition to Prince Edward Island only, not the season as a whole.

The "K2OAW" frequency counter has been in operation for over a month at this writing . . . it works perfectly. I would highly recommend it to anyone in need of a frequency measuring device. The next project for this station will be an outboard mixer to combine the vfo, carrier oscillator and heterodyne oscillator signals and allow continuous monitoring of the receive and transmit frequency. First thoughts are for perhaps a pair of 40673's – comments from those who have accomplished this already, would be appreciated.

The December openings won't be far off by the time you read this – is your rig in good shape and ready for the "Second Season?"

WAØABI



NEW CERTIFICATE THREATENED

It obviously had to come to this: a certificate for making one contact! The Navassa DXpedition crew of KC4DX have announced a certificate which is available to any operator who managed to get through the tremendous pileups and make a contact.

It is hard to believe that anything as nice as this is available for only one dollar! Why, that barely covers the postage and handling, not to mention having a little left over for the Atlanta club to put toward another expedition.

If you are one of the few lucky and persistent DXers who did contact KC4DX all you have to do to have this outstanding award is send a confirmation of the contact to His Eminence Chaz Cone, Box 11555, Atlanta GA 30305, include one dollar (minimum – no maximum has been set, but the members of the DXpedition do go around on bended knee a lot when hints of donations are made) – why not make it $2 – you'd spend that on a movie.

HOT GEAR

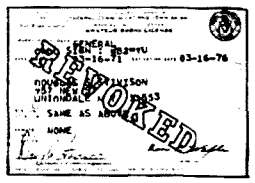
Yaesu FT-101 No. 107036	WA2YSW	4/72
Standard 2m FM No. 102703	W6NPV	4/72
Drake ML2 No. 20189	WB2LLR	4/72
Standard SRC-806M No. 009210	K1TLP	5/72
Aerotone 6M 355LT, No. 685064	RR Police Grd.Curl.Trml. NYC	5/72
Standard SRC-806M, No. 102703	C. Mathias 3234 Coronado Ave Imperial Beach CA	5/72
Lafayette HA-410 No. 009210	WA2KDG	5/72
Coll., 62S1 No. 10728	MSU ARC E.Lansing MI	6/72
WRL Duo-Bndr 6010AT302	WA6FCY	6/72
HR-2A, 11 chan., 04-07152	WA1NVC	9/72
Swan Cygnet 270,No. 313022	K4ACJ	9/72
Collins Mic, Mod. MMs, No. 4294	K4ACJ	9/72
Heath HW-100 & AC PS	WA2JGP	10/72
Swan 270B, No. M-395430	W8HST	11/72



RTTY PICTURES

We plan to run a RTTY picture every month in these pages. Have any particularly interesting examples you would like to see published? Send 'em in!

WITH THE FCC



MORE REPEATER RULES

Applications filed after October 17, 1972 – All amateur applications filed on or after October 17, 1972, must comply with the new rules adopted in Docket No. 18803.

Existing stations – A station operating as a repeater station, and/or one authorized for remote control, whose license was granted as a result of an application filed prior to October 17, 1972, should comply with the new rules adopted in Docket 18803 to the extent possible after that date, but must fully comply by no later than June 30, 1973. Applications for such stations received prior to October 17, 1972, will only be granted authorization for operation for the balance of the original license term without payment of additional filing fees. If a renewal or additional privileges are requested, normal filing fees will be required. Applications for station license modification filed after April 30, 1973, may not be processed in time to permit continuity of operation.

Waivers – The granting of waiver requests except under the most exigent circumstances are not contemplated.

Intra-community – The Report and Order and the rules speak of limiting repeater station coverage to intra-community amateur radiocommunications. In consonance with the rules limiting to two the number of repeater stations operating in tandem, intra-community is considered the maximum area covered by such a network.

Call signs – Beginning October 17, 1972, a license issued for a repeater station will authorize a call sign having the prefix WR followed by the number of the applicable FCC district. The suffix will be three letters assigned systematically starting with AAA.

AND MORE...

Rules amended to exclude business and commercial third party traffic from amateur operation; new rules proposed to permit limited compensation and to modify logging requirements.

Part 97 of the Rules has been

amended by the Commission to prohibit amateur operators from transmitting messages over amateur radio stations for business and commercial parties (Docket 19245). (Third party traffic is defined as amateur radiocommunication by or under the supervision of the control operator at an amateur radio station to another amateur radio station on behalf of any one other than the control operator.)

In a separate but related action, the Commission issued a Notice of Proposed Rule Making concerning possible limited compensation for amateur club station control operators and possible relaxation of the logging requirement for third party communications.

In a Notice of Inquiry released May 5, 1971, the Commission requested comments on whether any restriction on the use of amateur radio stations by non-amateur organizations was needed, and if so what those restrictions should be. The inquiry resulted from petitions to change the present rule (Section 97.39) which prohibits certain organizations from obtaining amateur station licenses or having an amateur operator use his station in their behalf.

The Commission said that radio communications, the sole purpose of which was to facilitate business and commercial traffic, was not in keeping with the intended purpose of the Amateur Service, and should not be allowed except for emergency communication. Amateur licenses will thus not be issued to schools, companies, corporations, associations or other organizations. The Commission explained that to prohibit third party traffic entirely would tend to stifle one of the basic purposes of the Amateur Radio Service, which is to provide a voluntary non-commercial radio service, but to allow all third party communications would tend to cause increased congestion in the amateur bands.

The rules become effective December 1, 1972.

The provisions of Sections 97.114(b) and 97.112 prohibit the American Radio Relay League's long standing practice of providing compensation to the control operators of station W1AW, which transmits code practice and informational bulletins of particular significance to amateur licensees. In a Notice, however, the Commission proposed rules which would allow this compensation and granted a waiver of the Rules to W1AW to permit it to continue operation pending final action on the Notice. It said that other club stations providing similar services may also apply for waivers. The Commission invited comments on whether to allow any *bona fide* amateur organization to operate a station and provide reasonable compensation to the control operator when the station transmits material solely related to the Amateur Radio Service or whether to create a new class of amateur station.

Comments were also invited on the usefulness of the Section 97.103(b)(3) of the Rules, which requires that an amateur radio station log include a notation of third party messages sent or received, including names of all participants and a brief description of the message content.

Comments are due by December 20, 1972, by Report and Order and Notice of Proposed Rule Making. Commissioners Burch (Chairman), Robert E. Lee, H. Rex Lee, Wiley and Hooks with Commissioner Johnson dissenting.

AMERICAN AMATEURS MAY EXCHANGE SATELLITE DATA WITH GERMAN AMATEURS

The FCC issued a Public Notice on the above on October 5, 1972. The text follows:

Information has been received by the Commission that the Bundes Post of the Federal Republic of Germany has no objection to the exchange of third party traffic with German amateurs relating to an exchange of technical data in connection with the launch of OSCAR 6 amateur satellite and throughout its orbit period.

Such third party traffic may be directed to other amateur operators in Germany only concerning the subject satellite operation. There is no change in the status of the general conditions relative to normal third party traffic between the Federal Republic of Germany and the United States. The Commission concurs, therefore, with the limited relaxation of third party traffic concerning OSCAR 6 and has no objections to Amaerican amateur operators engaging in such exchanges of information!

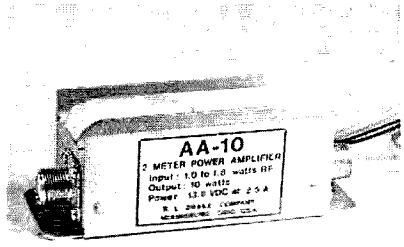


How many OM's recognize Rod VK3CR?



NEW PRODUCTS

10W AMPLIFIER FOR THE TR-22

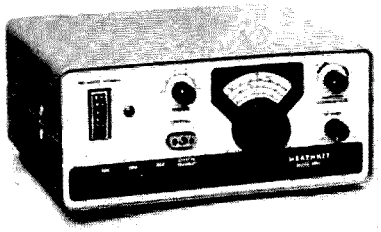


The R.L. Drake Company has finally expanded their FM line with a small piece of gear that will no doubt increase the happiness of a lot of already happy FMers. The specific unit is the AA-10 FM amplifier designed to be driven by the one watt available from a TR-22. Rated at 10 watts output, it will give you that extra punch that is lacking when just using the transceiver. While 10 watts alone is not exactly a high power figure compared to some of the mobiles running around today, the 10 dB gain available from this amplifier is bound to make a big difference in the number of repeaters that you can get through to.

Inside the case nestles a TRW PT4544 transistor mounted on the neatest circuit board you've ever seen. The T/R switching is all automatic through the use of diodes . . . no relays to clutter up things. The instruction book is very good and identifies each part along with complete directions on how to retune the unit if the need arises. I tried touching up the output a bit but was thoroughly disappointed. The Drake people had the audacity to sell us a perfect product! All the coils were exactly pretuned at the factory. There's just no fun in it anymore . . .

The amplifier is rated to operate with inputs between 1 and 1.8 watts. Feeding approximately 2/3 of a watt into it still produced a respectable output of 8 watts. With its compact size, a neat little transceiver could be wired up using those small commercial receiver and transmitter modules. Mount the boards and crystals in an attractive little case and mount the AA-10 on the rear. Right outside where it looks the best. the AA-10 sells for $49.95. Also available is a matching ac supply, the AC-10, for $39.95. From *R. L. Drake Co., Miamisburg OH.*

QRP TRANSCEIVER

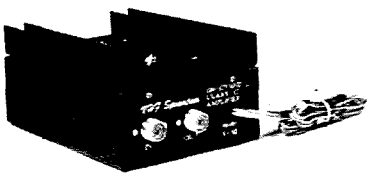


Heathkit has announced its entry into the QRP transceiver field with a new three band CW rig. The HW-7 is designed for 40, 20 and 15 meters with vfo or crystal controlled operation on all three bands. The receiver is claimed to have better than 1 μV sensitivity, which is pretty good considering that it is not a superhet but a direct conversion Synchrodyne. The transmitter input power is 3W on 40, 2.5W on 20 and 2W on 15 meters. While this is nowhere near enough power to leisurely earn a DX certificate (at home . . . in your spare time) you would be amazed at the contacts possible with only a few watts. In October WB2WYO stopped up at 73 while on vacation and I got a look at his nearly full log book. He runs 2W from a rig inside his camper to a piece of tuned wire strung out to the nearest tree. With this simple setup he manages to work across the country with 579 signal reports!

The best features of low power operation are portability and freedom from external power sources . . . ooops, don't forget fun! The HW-7 is designed to operate from an external ac supply or 12V batteries. Just plug in a fresh set and disappear into the wilderness for a while. What could be more appealing than operating portable VE8 from the banks of a wild river in Canada?

The HW-7 features push button band switching, sidetone and a relative output meter for tuning convenience. It sells for S69.95 from *Heath Company, Benton Harbor MI 49022.*

50W FM AMP



VHF Specialists offer a new Model 5-50 two meter amplifier for the serious FMer. Featuring two Balanced Emitter Transistors, it exhibits extreme sensitivity and tolerance to VSWR changes. No need to worry about damage if your coax is open or shorted. Although the input is rated at 5 watts for an output of 50, the high gain input transistor will amplify only one paltry watt enough to drive the output stage to 40 watts output! With such a wide range of input powers that can drive this amplifier to a respectable output, the unit makes an ideal "universal black box" for FM work. The only possible complication would be the failure of the relay transistor to get enough rectified rf under low power conditions. No real problem though . . . for the circuit manual gives complete instructions on how to compensate for this by trimmer adjustment.

It is amazing when you think about a seemingly small thing like package design in amateur equipment . . . a lot of manufacturers mount their circuit boards in a metal box and just drill holes for the power leads and connectors somewhere near the place of connection to the boards. Whoever packaged this little amp had some idea of what most of us would be doing with it – tucking it up out of the way somewhere. Notice how the power leads and both connectors are mounted on the same side of the case. With its small size of only 5x7x3, one should have no mounting problems. $89.95 from *VHF Specialists, P.O. Box 167, Vienna VA 22180.*

NEW HEATH SCANNER

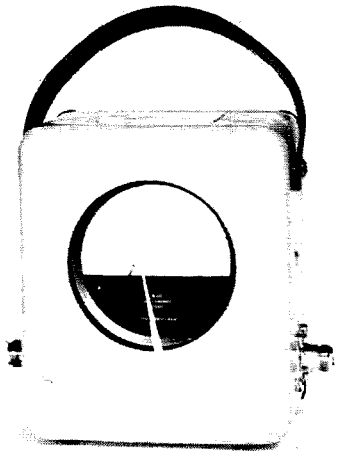


The Heathkit GR-110 Scanning Monitor brings you up to eight crystal frequencies to cover the active VHF bands in your particular locality.

The GR-110 can be tuned in either a manual or automatic mode. To tune manually, you simply depress the front panel "manual" switch to step to any desired controlled channel 0 through 7, which is read out by the digital channel indicator for fast identification.

In the automatic mode, the monitor scans rapidly through all eight channels and locks on to the first one that starts a transmission. It stays locked on that channel as long as the transmission continues. If transmission stops, the monitor will release the channels after four seconds and resume scanning. To bypass channels during the scan, front panel pushbuttons let you lock out any channels you desire. A priority channel is also provided which takes precedence over all other channels. The monitor automatically locks on to this channel whenever a station is transmitting even though it was already locked on another channel. The scanning monitor works equally well as a home or mobile unit. Line cords are provided for 120V ac or 12V dc battery power. A price of $119.95 and four evenings of your time will get you in on all the repeater action. *Heath Company, Benton Harbor, Michigan 49022.*

NEW BIRD WATTMETER



The new model 4342 Dual Wattmeter-VSWR Monitor displays the three prime rf transmission measurements at once on a single meter face: Forward and reflected power are indicated by individual pointers and VSWR is monitored on a third scale from the intersection of the two power pointers.

Unlike most VSWR meters, the model 4342 does not require *any* adjustments to full scale deflection, or any switching before VSWR readings can be taken. The entire set of three transmission parameters is read out simultaneously during normal rf operations or during maintenance adjustment procedures.

Power and frequency range of the new Bird Dual Wattmeter-VSWR Monitor depend on two plug-in elements selected from more than eighty choices available with the company's popular THRULINE Model 43. Full scale power levels at ±5% accuracy range from 10 to 5000 watts for reflected, in discrete frequency

Continued on Page 62 . . .

Robert T. Suding WØLMD
1955 Ingalls Street
Lakewood CO 80214

THE AFSA IV SSTV ANALYZER

Slow Scan TV has three key frequencies; 1200, 1500, and 2300 Hz. When receiving, the most critical is 1200 Hz, the sync frequency. When transmitting, the 1500 to 2300 Hz range is the critical area of concern. Here is how to build a unit which will solve both tuning problems.

The ideal method to find out what is happening to an SSTV signal would be to instantaneously analyze every Hertz generated and comparatively display them on an oscilloscope. The limits would be seen, plus gray scale, gamma correction, and transients. As a bonus, RTTY can also be displayed and instantaneous shifting errors analyzed. Complicated? Nope. $10 worth of IC's and transistors should do it, along with a surplus 'scope tube.

Theory

This unit measures the time the positive going portion of each cycle takes. For each Hertz, an oscilloscope sweep is triggered when the incoming signal crosses 0 and starts positive, and a vertical pulse is generated 180 degrees later when the signal again crosses 0 and starts negative. The trace is begun at the right side of the screen near the bottom and continues at a linear, semi-logarithmic or



AFSA as built by K7YZZ. Semi-logarithmic sweep.

logarithmic (your choice) rate towards the left near the bottom. The higher the frequency, the shorter time the Hertz will take, and the pulse will appear closer to the right side of the screen; whereas a lower frequency will approach the left side of the screen the closer it approaches the sweep frequency.

Three previous versions have been built and used by many of the active SSTV'ers over the last two years. AFSA IV uses an active high pass filter/limiter with a gain of 500, and a cutoff of 1200 cps with a rolloff of 40 dB per octave. Following this is a non-critical NPN transistor which acts as an inverting, clipping and interfacing stage to drive two TTL singleshots.

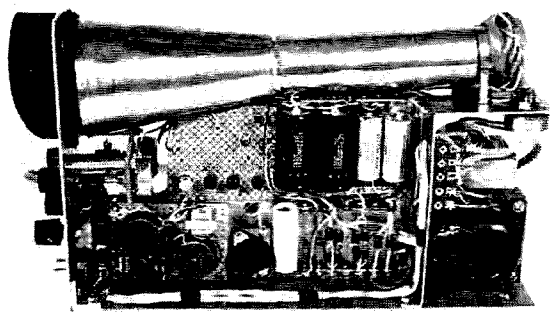
Positive going portions of the incoming frequencies trigger the delayer singleshot. Since the highest frequency of SSTV is 2300 Hz, the pulse at the end of the sweep would always take over 200 microseconds to occur, and if the sweep was triggered at the beginning there would be a considerable amount of wasted sweep. However, by using a variable singleshot delayer, the sweep may be initiated just before the expected 2300 Hz pulse.

The sweep op amp has a circuit which allows the user to select any rate and linearity desired by varying the ratio of two potentiometers, R3 and R4. The ramp linearity may be anything from exponential through linear (sawtooth) to logarithmic. Feedback is taken from the emitter of the high voltage output transistor to both improve the resulting ramp shape and the stability. Previous designs suffered from horizontal drift, but this one stays within 10 Hz from cold to very hot.

Back at the interfacing transistor, when the positive half of the Hertz is done, the vertical pulse generating singleshot is triggered. Size and clarity of the pulse can be varied with R1. Following this IC is a high voltage transistor which drives one 'scope vertical plate.

Construction

At the present time, I don't know of two identical AFSA's circuitwise, much less layoutwise. The 'scope tube may vary from 2 to 5 in., but most prefer the 3 in. size. A 3HP1



AFSA of K7YZZ. Inside right view. Utilized AFSA II circuitry. (Toroids instead of active filter, RTL instead of TTL Singleshots, not drift compensated. Used more parts.)

would be nice since it has a rectangular face 3 in. wide by 1 in. high. Some AFSA's are built as a separate unit, while I prefer to include it on the same chassis with my monitor.

The electronics are very non-critical and similar IC's and transistors may be interchanged with little effect. The ones specified are the simplest and cheapest that I had available. The layout should be in a rather straightforward manner to prevent feedback around the input/limiter stage, but other than that just keep the adjustment pots accessible. My power supplies are part of the monitor, but any reasonably well regulated design should work fine.

If you are building this unit strictly for RTTY usage on the standard mark and space frequencies, lower the active filter resistors from 9.1K to 5.6K and from 4.7 MΩ to 2.5 MΩ. This will then raise the cutoff frequency to around 2000 Hz.

Tuneup

At this point you have to make a decision on what you would like to do with AFSA. If you build AFSA IV as given, then use Table I or Table II to initially set the adjustments. Note that you have the choice of semi-exponential, linear, semi-logarithmic, or logarithmic.

My SSTV choice is semi-logarithmic. This gives an expanded portion around the sync frequency range of 1200 to 1500, but still doesn't crowd the video range of 1500 to 2300 too badly. The linear sweep settings

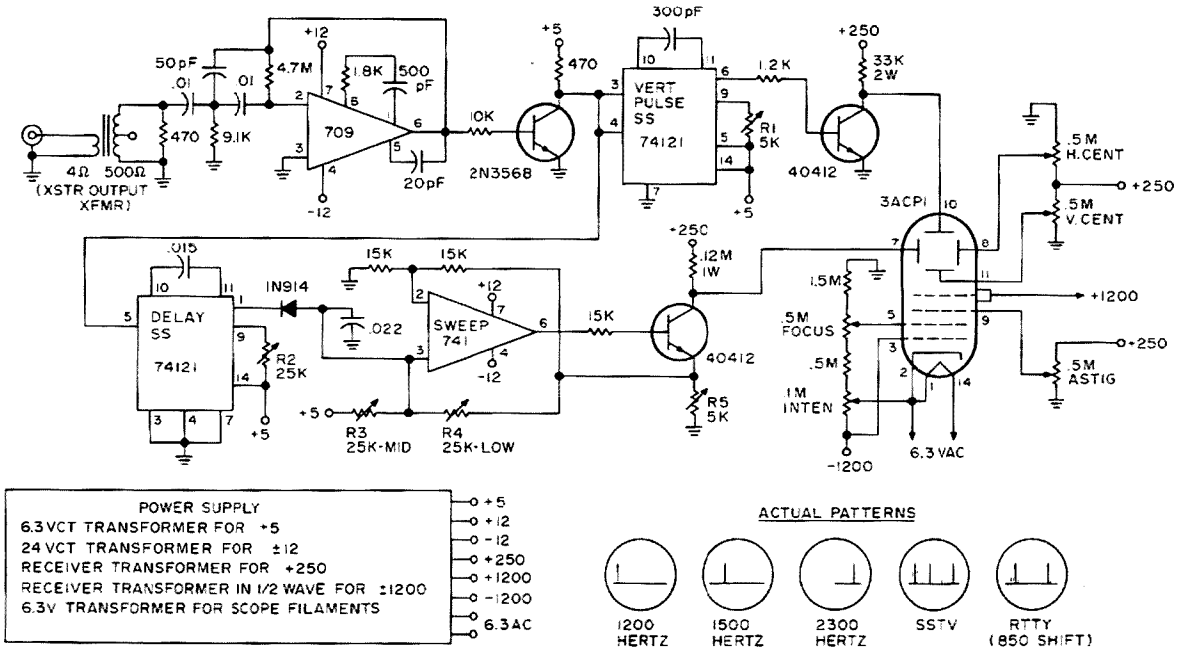


Fig. 1. Schematic diagram of the AFSA IV SSTV analyzer.

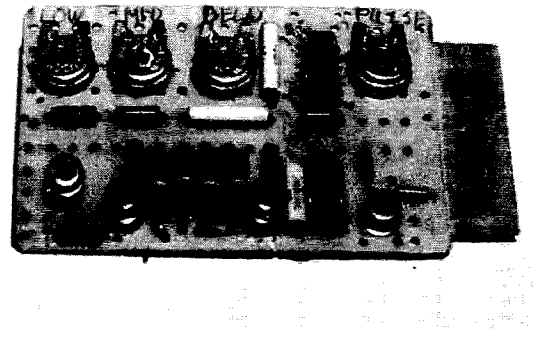
will give a logarithmic display of frequency which seems to crowd the high end. It does give a very good indication of unstable sync pulse frequencies and transients occurring in the range between 1200 and 1500. The logarithmic sweep will produce a linear display of frequency (e.g. 1200–1300 Hz will be just as much separated as 2200–2300 Hz). This display is good for measuring and interpolating frequency departures from the standards.

For RTTY use, logarithmic sweep will enable straddle tuning, but it tends to make 170 Hz shift signals difficult to tune due to the small separation in frequency. Linear sweep produces a nice picture, and a semi-exponential sweep would give even better separation to the narrow shift. However, straddle tuning becomes quite difficult unless fine calibrations are made when calibrating the scope frequencies with linear or semi-exponential shift.

I set up the sweep for SSTV use by using an audio generator at 1500 Hz and adjust the sweep width (R5), horizontal centering, and vertical centering for a horizontal line that just sweeps the entire face of the 'scope about 1/3 up from the bottom. The pulse should appear somewhere around the center of the screen. Adjust the pulse width control so that the pulse is a sharp line extending up from the base line to about 1/3 down from the top of the screen.

Next I set the generator to about 2500 Hz and adjust the delay (R2) to get the pulse just inside the right edge of the screen. After this low sweep (R4) is adjusted to that 1100 Hz is just inside the left edge of the screen. Middle sweep (R3) is adjusted so that 1750 Hz for logarithmic, 1600 Hz for semi-logarithmic, or 1500 Hz for linear occurs in the middle of the screen.

For RTTY, I adjust sweep width (R5) using 2400 Hz. Adjust delay (R2) using 3100 Hz. Adjust low (R4) for 2000 Hz. Adjust middle (R3) so that 2400 for semi-



AFSA III Circuit card of WØLMD. Except for some slight changes, identical to AFSA IV card. Input stage on another card in monitor.

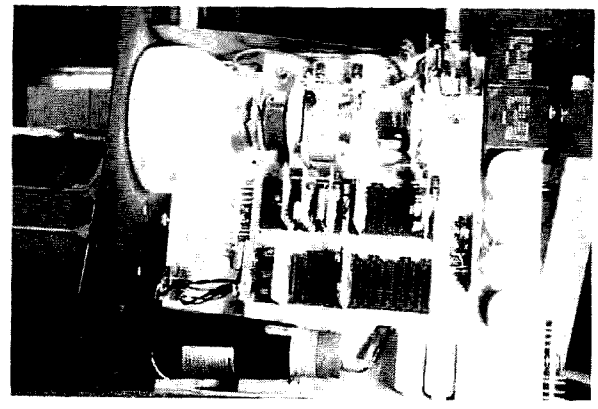
exponential, 2450 for linear or 2550 for logarithmic occurs in the middle of the screen.

Since the adjustments interact, it is necessary to go through the adjustments several times. A 'scope attached to the output of the HV transistor will show the effect of the changing ratio of R3 to R4.

Using

After tuning, swing the audio oscillator through the SSTV or RTTY range. You will notice that the pip will exactly follow the audio oscillator's output frequency. You can now calibrate the screen using a felt tip pen, tape, or decals. For SSTV, calibrate 1200, 1500 and 2300 Hz with long lines. Then calibrate 1300, 1400, 1700, 1900, and 2100 Hz with shorter lines. For RTTY, I place long lines at 2125, 2295 and 2975 Hz. Shorter indications are placed at the crossover points of my TU at 2210 and 2550 Hz.

Now hook up AFSA to an SSTV signal, preferably your own in closed loop at this point. You should notice a considerable amount of "grass" in the 1500 to 2300 Hz region corresponding to the video information. At 1200 Hz there should be a faint pip, brightening on the vertical sync pulse. Now, for a bit of fine reading. You will notice faint pips in the "dead area" between 1200 and 1500. These are transients caused by sync time switching in the middle of a Hertz. Some stations use severe clipping to achieve a contrasty picture. When looking at these on AFSA a world of transients appears. This shows why these pictures sync so poorly. AFSA shows that very few stations use the full video range. Most stations crowd the white frequency (2300), the black frequency (1500), or both, which results in a lack of gray scale (naturalness). The correct picture as displayed on AFSA IV will have few transients in the "dead area," no dominant bright lines at 1500 and 2300, but a lot of action in between.



Top view of monitor and AFSA IV. AFSA IV card is immediately above 3ACP1 tube socket. Monitor is IC magnetically deflected using a 7 in. tube.

When QRM increases so that the gray scale is not so important, contrast should be increased so that 1500 and 2300 begin to show brighter lines, but not so much that transients appear in the "dead area." Note that your 1200 Hz horizontal sync pulses dance around a bit. Mine are stable within 20 Hz of 1200, but some stations may wobble up to 70 Hz. And that hurts! (Pun intended.)

Those stations with excess transients and sync wobble are seldom copyable except under ideal conditions. I believe the sync wobble is caused by lack of symmetry in the

Table I – SSTV

	R1 (Pulse)	R2 (Delay)	R3 (Mid)	R4 (Low)	R5 (Width)
Linear	2K	18K	20K	13K	4K
Semi-log	2K	18K	10K	22K	4K
Log	2K	18K	5K	25K	4K

Table II – RTTY

	R1 (Pulse)	R2 (Delay)	R3 (Mid)	R4 (Low	R5 (Width)
Semi-exp.	1.5K	15K	25K	3K	4K
Linear	1.5K	15K	7K	4.5K	4K
Log	1.5K	15K	2.5K	9K	4K

multivibrator section of the camera, too sharp of a filter following the MV, or frequency cutoff in the transmitter or receiver.

With RTTY, a similar situation exists. AFSA should just show bright lines at the mark and space frequencies with less than 25 Hz wobble, and a slight amount of switching transients in the "dead area." Few RTTY stations are this clean. Most show considerable "chirp" caused by dirty and/or corroded contacts, very poor AFSK units and low pass filters, and passband troubles in transmitter or receiver. After seeing all of the "crud" transmitted, it's quite a tribute to the machine. It copies anything. As with SSTV, this is why some stations are wiped out by the slightest interference.

Parting Pips

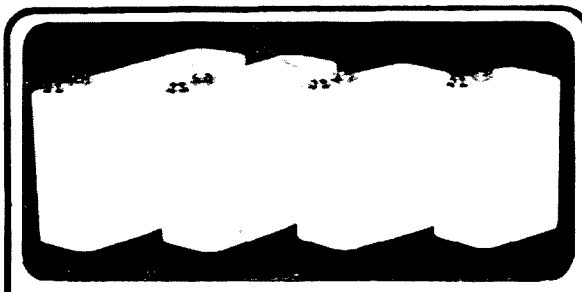
1. A 709 & 741 in the metal can have a tab next to pin 8.
2. The 74121, and 709 & 741 in the dual in line case have an indentation on the top between pin 1 & 14 (8).
3. Polypaks, Allied & Newark handle most of the parts.
4. The transmitter inverter can be any switching NPN.
5. The output High Voltage Transmitters may be any capable of at least 250V and a few megahertz.
6. AFSA requires a noise and QRM free signal for best frequency discrimination. Avoid giving reports under marginal conditions.
6. A future improvement that I am going to add is a blanking circuit so that only a dim horizontal line is visible compared to the vertical pips. The vertical pips will then also provide an unblanking pulse. For a method of blanking, refer to *73*, June '66, p.15.
8. A dual trace 'scope tube should be considered. On SSTV, use a 5 in. dual gun P7. Use a yellow filter for the SSTV monitor and a blue filter for an AFSA display at the top or bottom of the screen. For RTTY use a dual gun tube with a medium or fast phosphor decay and build a "flipping line" display at the top and AFSA IV exponentially swept at the bottom.

. . .WØLMD

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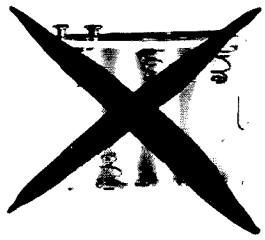
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SINGLE CONVERSION TWO METER FM RECEIVER

Four transistors and an IC

The following is a description of a build-it-yourself two meter FM receiver using two new components to achieve a single conversion job for narrow-band FM amateur use. It produces plenty of good, clean af from a total transmitter deviation of 10 kHz.

The Trend to Multi-Function IC's

Once again the broadcast industry has created a component of considerable interest and utility to amateurs. This is the RCA 3089E chip, in a plastic 14 pin case, ¾ x ¼ x 1/8 in., containing some 63 transistors, 30 resistors, and 14 diodes. The major block functions and transistor count in each follows: i-f amplifier (22); quadrature FM detector (10); audio preamp (13); level detector and meter circuit (15); squelch drive (4); bias supplies (10); agc buffer (1). The price of all this? . . . $3.63.

The Trend to Ceramic or Crystal Filters

This has led to a unit ¾ long x 3/8 in. thick, in a two pin metal case, which furnishes all the selectivity needed for narrow-band FM in the i-f section. This little tin can takes the place of quite a number of tuneable coils and stays right there on frequency at 10.7 MHz. You can't change it even if you want to. It works!

Receiver Block Diagram

Figure 1 shows how simple it all is (?). Here we are back again with a single conversion, after decades of double and triple conversion jobs. The individual circuits of each block, the rf, mixer, L.O., i-f and af, are all shown in detail, with two-terminal connections between each block, so no overall schematic is needed. Many pages could be written on the philosophy of design, but this is a construction article, so here we go right into the thick of it.

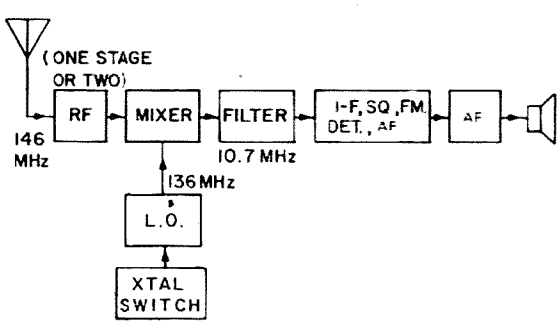
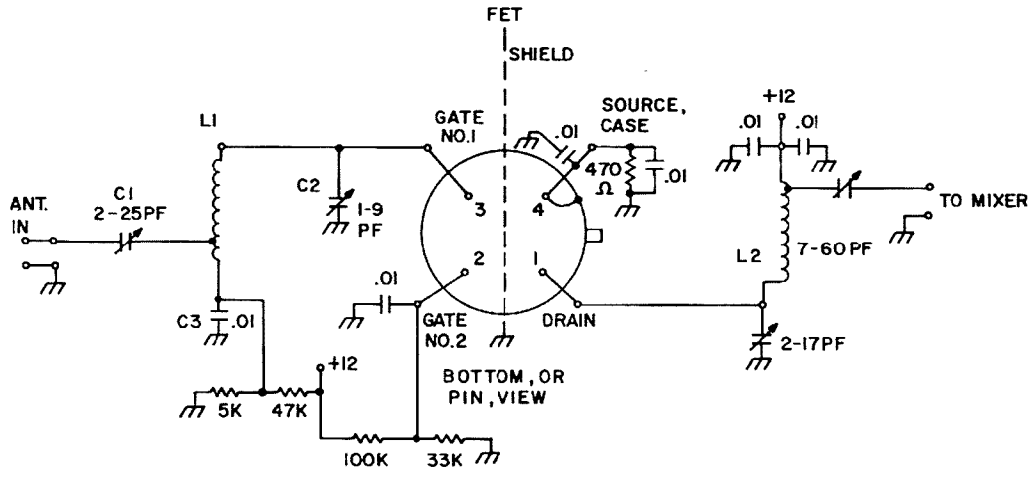


Fig. 1. Block diagram of 2m FM receiver.

The Tuner

Figure 2 shows the rf stage schematic using the "insulated protected dual gate metallic oxide semiconductor field effect transistor" (to give its true full name). You can treat these little gems almost like a tube. The "almost" refers to the need for fixed bias as well as self bias if you want maximum gain as well as anti-spurious, anti-inter-



C1 TRIM. 2-25 P.F.
C2 JOHNSON TYPE M, 9 PLATE
L1 = 4 TURNS COPPER NO.14, 1/2" O.D., 3/4" LG., TAP AT 1/2 T.
L2 = 3 TURNS, TAP AT 1/2T, AS L1

NOTE 1 PIN 4 MUST BE BYPASSED WITH AS NEAR ZERO LENGTH LEADS AS POSSIBLE

NOTE 2 ANY GOOD UHF OR VHF FET, 3N200, 40819, 40673, OR SIMILAR

Fig. 2. FET rf stage.

modulation, and anti-overload characteristics all in one tiny package. These features are aided by *separate* bias adjustments for each of the two gates. While this is optional and not critical, it helps.

There is one place in the rf stage you must pay attention to in order to allow full gain without neutralization. You must use the shortest possible leads and low inductance capacitors (preferably no leads at all) on the source bypassing. This is the transistor element similar to a cathode or an emitter. If you don't, it will oscillate when lightly loaded. Fortunately gate No. 2 is so arranged internally that it acts as a shield, somewhat in the manner of the screen grid of a tube. Use short lead bypassing also, although it is not as critical as the source.

With these precautions the FET stage will give high gain and low noise without neutralization. One rf stage is shown, but another can be used for maximum sensitivity and minimum noise figure.

Mixer

This is another dual gate job, with the nice feature of having the signal on one gate and the L.O. on gate No. 2, just like two grids in the old mixer tubes. Here is where careful adjustment of *both* fixed bias voltages will pay off in rejection of spurious, intermodulation, and overloading. You can leave it as is in the schematic, or make checks yourself if special conditions occur at your location. One thing I found (there are always things to trip you up which are not "in the book") that you should watch for, is oscillation due to the fixed bias on gate No. 2 being too high.

Testing of Front Ends

In order to get everything right, promote smooth tuning and operation, determine best component values, whether or not any component or voltage is critical, and to find out in general what makes a given circuit tick, I use a broad-band, low sensitivity i-f for the first go around. With the rf stage in front of the mixer this was simply an AM detector tuned to 10.7 MHz, a dc meter, and plenty of audio. With no limiting, no FM, everything you do to the front end shows immediately. This method also accommodates easily to a low cost signal generator, whose attenuation is never sufficient for a sensitive receiver.

Final Word on Gate No. 2 of the Mixer

Reworking the component values for the mixer, I again ran into oscillation when the dc bias was too high, this time showing up in the rf stage, even though there was no trouble there. So keep your eye on gate No. 2, it's a little touchy if you try to raise the mixer gain by too much bias. It does go up that way but being a form of regeneration, it

rapidly becomes unstable. A good stable second stage of rf is much better – and safer.

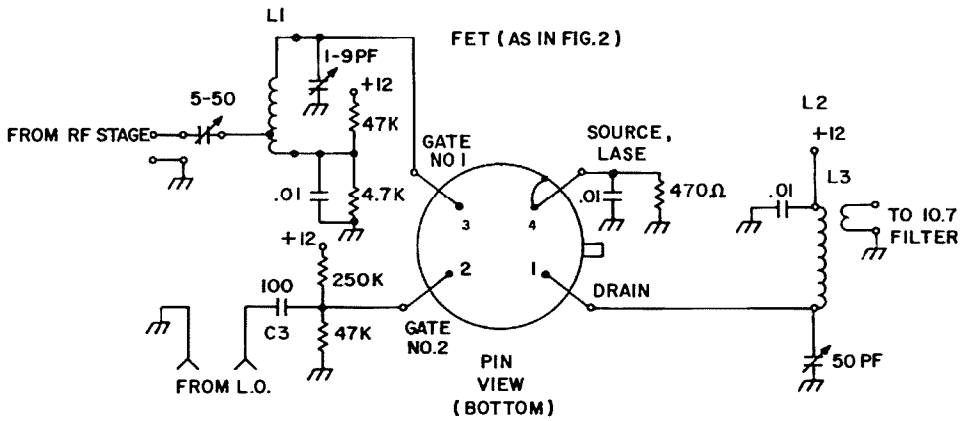
For maximum mixer sensitivity use plenty of L.O. power and gate No. 2 will operate fine without any dc bais. Just use a 47K resistor to ground.

Local Oscillator

This 45.3 MHz crystal oscillator and tripler to 136 is more or less standard, with the exception of the electronic switching of the different channel crystals. Building diode switching into the rig from the start allows you to put the switch anywhere you wish, one of such places being on a small panel under the dash of a car while the rig is out of sight back in the trunk or a similar concealed location. Some number of crystals should be decided on, such as 6 or 12, or leave enough space to install later as many as you decide to use. With this type of channel receiver no other type of tuning is available, so plan ahead.

Figure 4 shows the circuit, and if you haven't yet worked with electronic switching, don't let it worry you, it works. The switching diode is simply in series with the crystal; or rather, there is a diode in series with each crystal, and if no dc is applied to the diode to turn it on, the oscillator feedback path is cut off. When one of the diode resistors is grounded, making it conductive, current flows through the diode and, presto, you're on the air. Yes, there is some attenuation through a single diode, but inasmuch as L.O. power required is never very large, this is not troublesome if you provide for it. L.O. "tweaking" is provided by capacitor C1, which also is in series with the crystal. C2 also provides some frequency adjustment to the precise center of a given channel. Remember that between various rig and crystal manufacturers, quite a few cycles of variation can be expected – and indeed shows up – between what one considers to be, for example, "146.940 MHz" and the next. Presumably, a properly functioning counter can be used to correct this problem. However, I present the following two facts: Almost all rig makers install tweaking capacitors, and expensive ones at that, on both receivers and transmitters; secondly, two of the strongest repeaters I receive here on "146.940' heterodyne each other at something like 500 cycles. So put those tweakers in your rig, too.

You have only one conversion to think about in this receiver, but then you do have the sharp filter to consider. This is up to the maker, of course, and the first one I tested was well within the capability of the two tweaking capacitors mentioned above. The user (you) will probably think that for around $10 the manufacturer should be able to put it right on frequency, but if you have ever tried to make and sell something for "anybody" to use, you know there is



L1 = 3T. COPPER, NO. 14, 3/8"O.D., 1" LG., TAP AT 3/4 TURN FROM LOW END

L2 = 50 TURNS, NO. 34 DCC ON PHENOLIC FORM 1/8"O.D., 1/2 LG. WITH 6-32 IRON CORE TUNING SLUG OR SIMILAR. TUNE TO 10.7 MHz

L3 = 3 TURNS

Fig. 3. FET mixer stage.

another side to that story. At any rate, it works, and works well.

The tripler gives out with plenty of 136 MHz power, although you must get this into the second gate in proper fashion. After trying various types of cable connections, I found it better to go right into the gate from the top – or hot end – of the tripler coil. Of course, be very sure that the tripler *is* on 136 MHz by using a grid dipper or tuned diode to check this. Do *not* rely on a sensitive receiver. It is best to couple the tripler output into a diode receiver and meter, with audio to check on spurious, and test carefully for smooth tuning of both oscillator and tripler and also for switching and power. Do *not* allow marginal operation anywhere along the line such as "just on" or "just enough power" which will surely cause you trouble later on with a low battery, aging, etc.

The 10.7 MHz Filter

There is not much you can do to this one. It only has two terminals on it, one input and one output, and a ground connection and absolutely no tuning. It's well worth the price if you consider the alternatives of a lot of i-f coils plus tuning up.

The i-f, Detector, and af Preamp Block

The RCA CA 3089E FM i-f system is quite a device, for my money. The internal block diagram is shown in Fig. 5. This little ¾ x ¼ in. flat pack is of course the heart of this whole receiver. The moment I hooked it up and threw the switch, things happened, with no waiting around. Plenty of "interstation" noise, because I always leave the squelch until last, and tremendous sensitivity at the input. One inch or so of wire touched to the input and SW stations all over the world start piling in. With everything flat on a copper clad baseboard and/or in a metal box, it works fine for 3 dB points. This is for the i-f alone, without the front end. FM demodulation is by quadrature detection (of which more later). A logarithmic type meter output (S meter) is buffered, and the delayed agc for the rf is, also. AFC, which you may not use right away, is also brought out, and last but not least the squelch noise amplifier is included as well as the proper af input for the dc it produces.

The quadrature detector deserves and gets special mention here. When used in a BC FM set, its single tuned coil is shunted by a resistor and it is fed from the i-f by a choke coil in order to demodulate total deviations 150 kHz. To demoduate narrow-band FM, down to a total deviation of not more than 10 kHz, a high Q coil, no resistor, and a low value capacitor to the coil from the i-f must be used. The quadrature type detector used instead of a discriminator has seen long service in TV work. It functions, simply put, by virtue of its high Q which stays more or

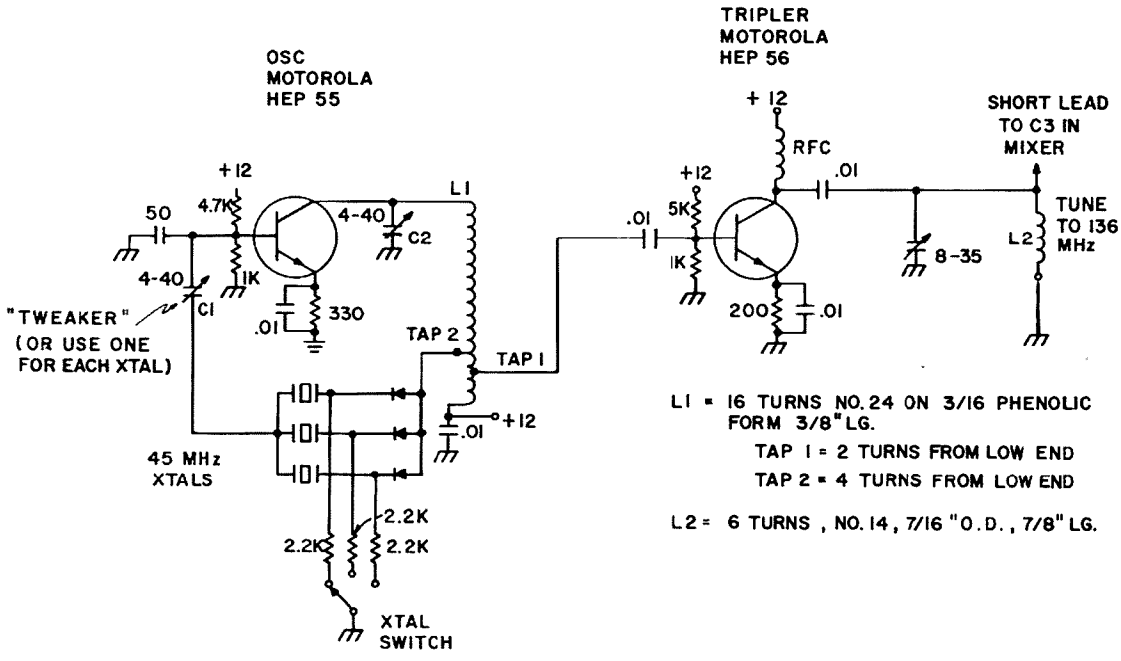


Fig. 4. Oscillator and tripler.

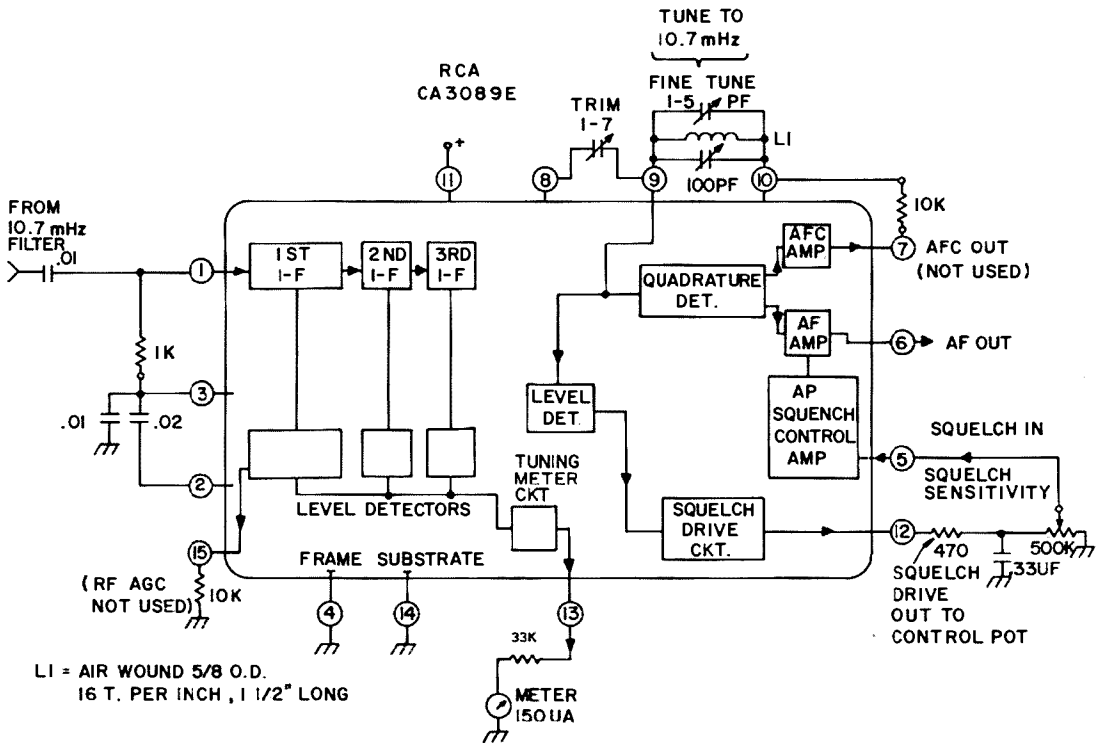


Fig. 5. I-f, audio, and squelch connections to CA3089E.

less on frequency – 10.7 MHz – while the incoming signal dances up and down with FM modulation above and below, unbalancing the detector which then produces nice, clean audio.

In order to do this correctly, the high Q coil must be tuned in exactly at the right spot, at 10.7 MHz, with a precision of a few hundred cycles at least. Actually, in practice, it isn't all that difficult. I just use a small fine tuning capacitor of 5 pF across the main 100 pF capacitor recommended for high Q, and on repeater voice modulation it is no more difficult than tuning a good receiver. And of course you then leave it that way. The series capacitor can be used to sharpen this tuning or broaden it, as you wish. Then it also is left alone. I'm just giving you some of the fine points of tuning up the quadrature detector, which is actually easier than tuning up a discriminator.

Just for fun, Fig. 5 shows you the various functional blocks in that miracle chip. Those "level detectors" shown are summed and sent to the tuning meter. This produces tuning indication even on strong signals, which are limited out at the detector. Detector "side-tuning noise" is greatly reduced by its careful application, all done internally for you by RCA to the squelch output, a nice feature. I recommend RCA Application Note ST-4698, "Advances in FM Receiver Design" for a more detailed description of everything that goes on in those 63 transistors in that little box. *(RCA/Solid State Division, Somerville, N.J. 08876)*

AF

This is the old story here, the tried and true one watt Amperex TAA-300. You can use your own favorite af if you have one. Five watts might be a little better in a noisy car. The Amperex is flat from 25 Hz to 25 kHz, leaving you plenty of room to trim response as you wish.

Results

I have logged so far 13 repeaters here, up to about a hundred miles, with a 38 in. piece of vertical aluminum, gamma matched to some 50 ft of ten-year-old 58/U cable.

This is a practical and working single conversion two meter amateur narrow-band FM receiver. It has been constructed and tested and circuit details furnished for the do-it-yourself crew.

P.C. boards are available from Bill Hoisington.

...K1CLL

Bob Way WA9VGS
12116 W. Belmar Drive
Hales Corners WI 53130

THE MOS-TONE ENCODER

This tone burst encoder for 2-meter FM repeater access is literally built around an MOS quad NOR gate (RCA CD4001/D or CD4001E), and boasts the following features:

- Miniature size – volume less than 0.5 cu. in.
- Very low current consumption – less than 3 mA with average operating conditions during tone generation
- Excellent temperature stability
- Simplicity – a dozen readily available components
- Versatility – can be easily adapted for multiple tone operation

The photographs tell the story about the compactness of this neat little gadget. W9ZDI's original unit is encapsulated in epoxy and mounted inside the case of his handi-talkie. Incidentally, if the MOS-Tone is used with a battery operated rig, or with any rig with a well regulated power supply, the voltage regulating components R1, C1, and Z1 can be omitted.

W9ZDI ran temperature stability tests on the tone generator, with very pleasing results. At room temperature the unit's output was trimmed to 2,250 Hz, which is the access tone for the local Milwaukee repeater, WB9ADX (146.34/76). The temperature was then lowered in a cold-chamber to -70°F (a little colder than it gets in a car that has been parked outside all day in Milwaukee in January), at which point the tone had increased a mere 7 cycles (0.3 of 1 percent!). When the unit ambient temperature had been elevated to 200°F the tone dropped but 18 cycles (0.8 of 1 percent). Hence we cautiously proclaim this unit suitable for mobile mike installation in most climates. If further information is desired on the temperature compensating features of this integrated circuit oscillator, as well as the derivation of the RC time-constant equation, see RCA Application Note ICAN-6267 (2/70).

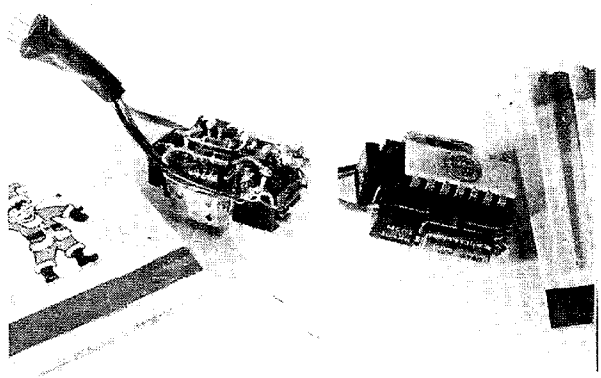


Fig. 1. MOS-Tone assembled by W9LCD measures 1" x 3/4" x 5/8".

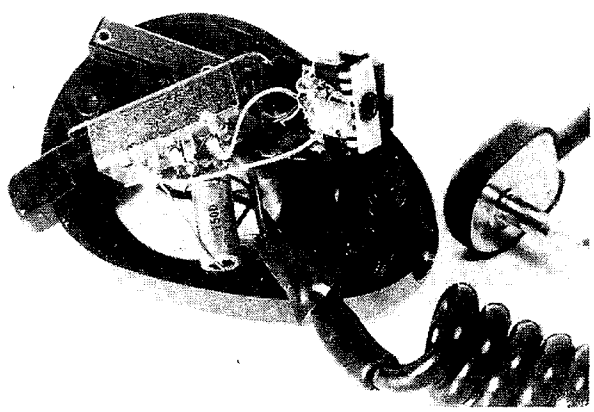


Fig. 2. MOS-Tone built into Regency HR-2 microphone by W9KQD. Long rectangular object in upper left is trim pot.

Theory of Operation

Referring to the schematic diagram of Figure 3, the first two NOR gates (pins 1-6) are connected as a multivibrator, the operating frequency of which is set by the time constant of R3-C2. Table 1 shows the approximate values of R3 for tones from 1,800-2,500 Hz, provided C2 is 820 pF. Fine frequency adjustment is accomplished by varying R2 (see Construction Notes). The third NOR gate (pins 11-13) is a buffer from which the output is taken. The output at pin 11 swings from 0 volts to the full B+ voltage; so R4, R5, and R6 attenuate the tone so that you can "talk over it." To decrease the tone still further, decrease R6 or increase R4. The final NOR gate (pins 8-10) is the timing circuit. The time constant of C4-R7 is about 0.5 second. As C4 charges, pin 9 goes "lo", which is inverted by the NOR gate to a "hi" at pin 10. This "hi" appearing at pin 6 shuts down the multivibrator. The buffer is deactivated in the same manner at pin 13, and prevents any possible chirp on the tone as it is cut off from reaching the output.

Construction Notes

All components are soldered directly to the pins of the dual in-line IC socket. Those that won't fit between the two rows of pins are left with slightly longer leads and are bent up around the sides, top, and bottom of the socket. The exact arrangement will depend upon the parts you come up with and your ingenuity. While the wiring is not critical, lead lengths should be kept as short as possible since stray capacitance will alter the tone frequency. One-eighth watt resistors are adequate. R3 and C2 should be high quality parts since their temperature coefficients govern stability. R3 should preferably be a thin-film, 1-percent precision type, and C2 a mylar or

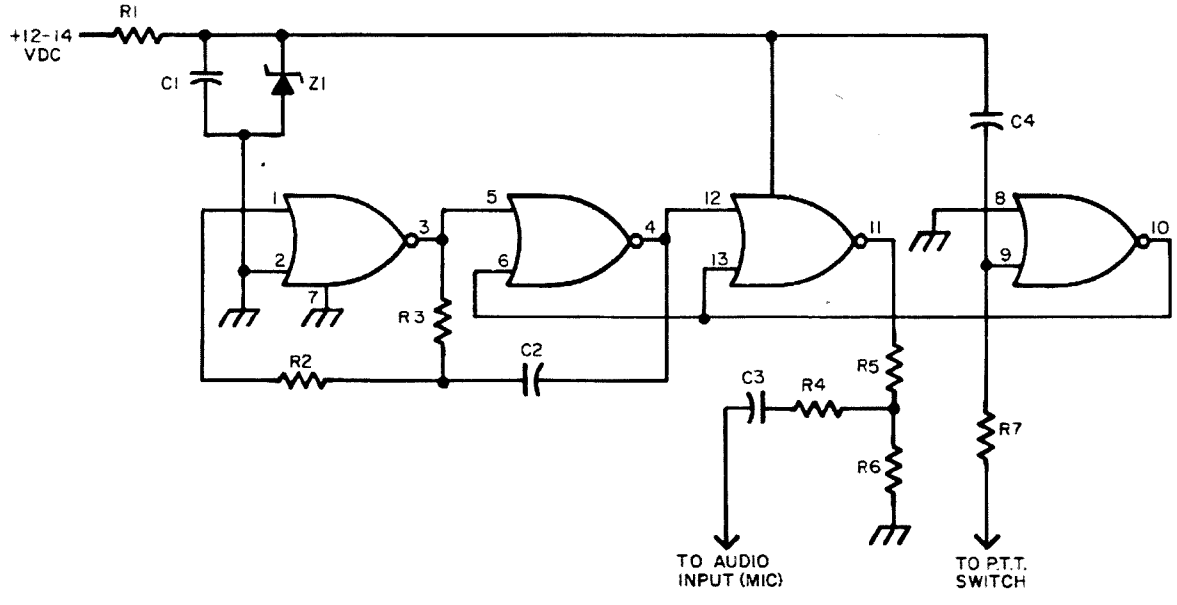


Fig. 3. Schematic of the MOS-Tone generator.

R1 – 1 k
R2 – 910 k - 1.1 M
R3 – (see Table 1)
R4 – 51 k
R5 – 51 k
R6 – 510 ohms
R7 – 11 M

C1 – 5 μf or greater, tantalum
C2 – 820 pf, mylar or silver mica (see text)
C3 – 0.047 μf
C4 – 0.082 μf
Z1 – 6-10 volt Zener diode

silver mica. The easiest way to fine adjust the tone frequency, if you have room for an additional component, is to connect a miniature trim pot, (100 k ohms or so) in series with R2 (see microphone photo). If it is desired to have the encoder adjustable to several different tones (for mobiling in areas where there are two or more repeaters), two schemes are available: (1) substitute a pot for R3 or (2) install a multiple-position rotary switch to select from several different small value resistors in series with R3. (These resistors could be 5 percent carbon types.) The switching arrangement shown is for use with rigs that use +12 volts to activate the push-to-talk relay, or the B+ line can be keyed. Still other arrangements are probably possible.

Conclusions

Several of these units have been built up by 2-meter FM ops in the Milwaukee area, and all are giving good service. If you wish an assembled and tested MOS-Tone, write W9ZD1 giving your frequency, tolerance, and size requirements.

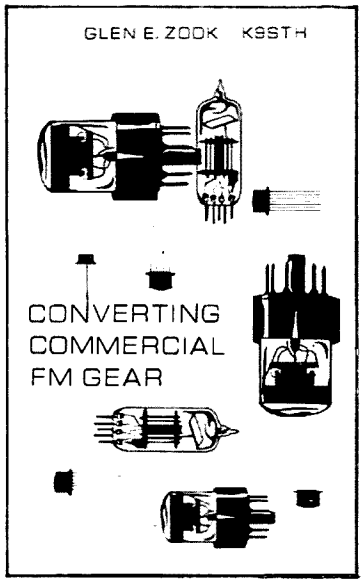
Tone (Hz)	R3 (k-Ohms)	Tone (Hz)	R3 (k-Ohms)
1,800	288	2,200	231
1,850	279	2,250	226
1,900	271	2,300	220
1,950	264	2,350	215
2,000	257	2,400	210
2,050	250	2,450	206
2,100	243	2,500	201
2,150	237	2,805	178.5

Table 1. Value of R3 for various tones, when C2 = 820 pF

. . .WA9VGS

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A SHORT TONE BURST DECODER

For simple time control functions

Certainly many articles on repeater control have appeared in the pages of 73 Magazine. Actually, more so than in any other journal both amateur or professional. One thing that you may find interesting, however, is that these unique applications do not necessarily have to apply to FM. All sorts of applications can be devised using small signal activated timers which are accurate, reset themselves, use somewhat standard voltages, and are able to withstand continuous service at very low power drains.

The following circuit was built for a paging application, but serves well in many other applications without modification. It could easily provide accurate control for FM repeaters – as well as something as simple as turning on your front door light with a toot from your (yours alone) auto horn . Other applications include: an automatic answer-back circuit for autostart RTTY, or by switching in a solenoid – snap an automatic picture from a SLOW SCAN MONITOR with the world's first SSTV autoscan.

The Circuit

The outstanding feature of this decoder is that it will respond to a 100 ms pulse of no greater amplitude than -10 dB. Anything greater or longer is a waste of time and energy. The keying bandwidth is less than 50 Hz and that's plenty of selectivity.

The tones activating the decoder, therefore should be relatively high in the band pass and in this case we chose 2805 Hz, because the lower frequency voice components of 100 ms duration could easily trigger the unit.

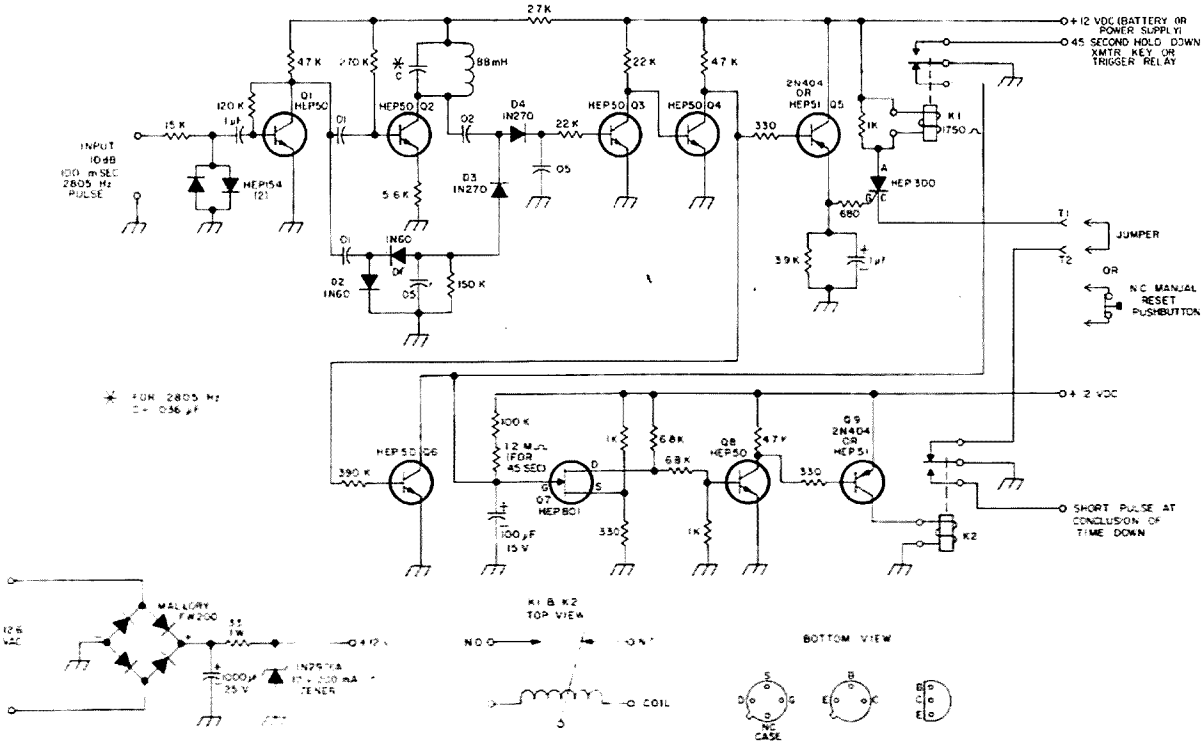
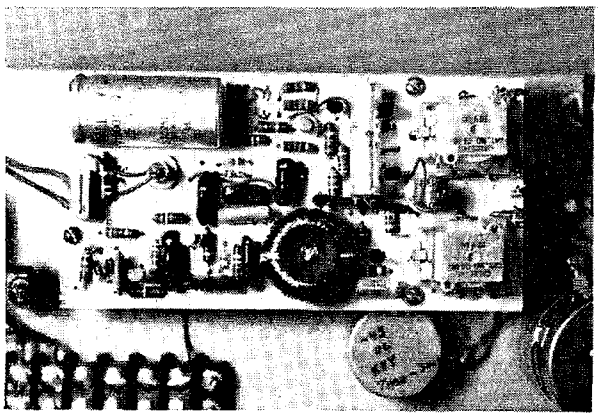


Fig. 1. Schematic of short tone burst decoder.



By sticking together some previous RTTY circuits (see Fig. 1), and using some of the suggested circuits in the current HEP Technical Tip Brochures (HMA-33), plus a few refinements, the following circuit does the job very well.

A signal of very low amplitude is unimatched to the base of Q1 (with clipping added if the level is not controlled). No matching problems were encountered and we have been successful in triggering everything from 3.5Ω to 20K with little or no signal loading or adverse effects in keying. Q1 amplifies the slightly clipped signal and drives Q2 and the 1N60 diode (negative) voltage doubler. Q2 amplifies the signal further and drives the collector LC circuit tuned to the desired triggering frequency. The combined amplified input and insertion loss of Q2 just about equals but is slightly greater than the output of the negative voltage doubler driven by Q1. The positive voltage doubler is connected in its parallel leg, not to ground, but by way of the filtered output of the negative supply. The combination keeps CR4 from supplying base/emitter current to Q3 until the positive voltage derived from the LC leg overrides all other audio on the channel. Q3 is made to conduct switching off Q4. This supplies an amplified pulse to Q5 and Q6. Q5 is normally off and when switched, supplies an inverted gate current to the Thyristor. In my original experimentation, the current draw required to hold the Thyristor into conduction was not enough so the relay K1 was loaded down by the 1K resistor. Although this was not the best thing to do, I later discovered that the very light load on the relay minimized the effects of heating or inductive spikes.

The relays are identical DPST imports made by the Calectro Corp. (DI-967, 12V, 5mW). They were selected because of price and size. The NC pole of the relay holds the timer gate of Q7 to ground until the Thyristor gate is keyed by Q5. The relay then supplies a ground to the NO contacts which can be used to key the transmitter or a slave relay of higher power. Ground to Q7 is released by this action and the 100 μF capacitor is allowed to charge through the 1.2 meg resistor. It takes 45 seconds for C1 to charge sufficiently to "pinch off" Q7,

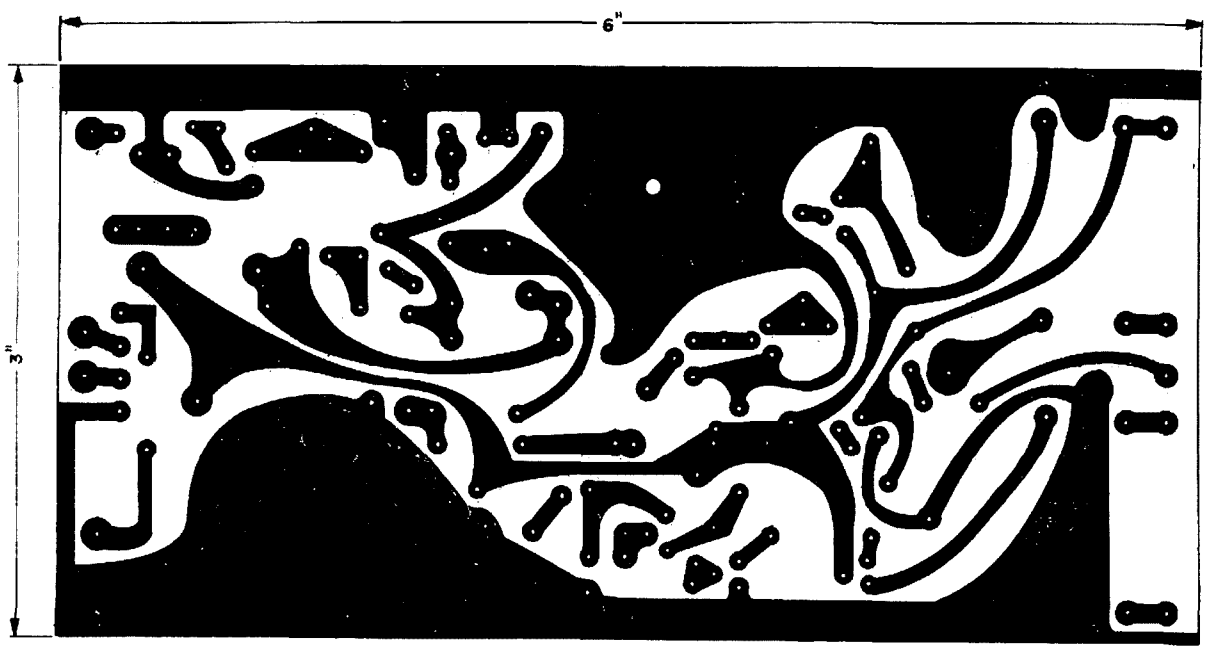


Fig. 2 Circuit board of decoder shown foil side up. (80% reduction)

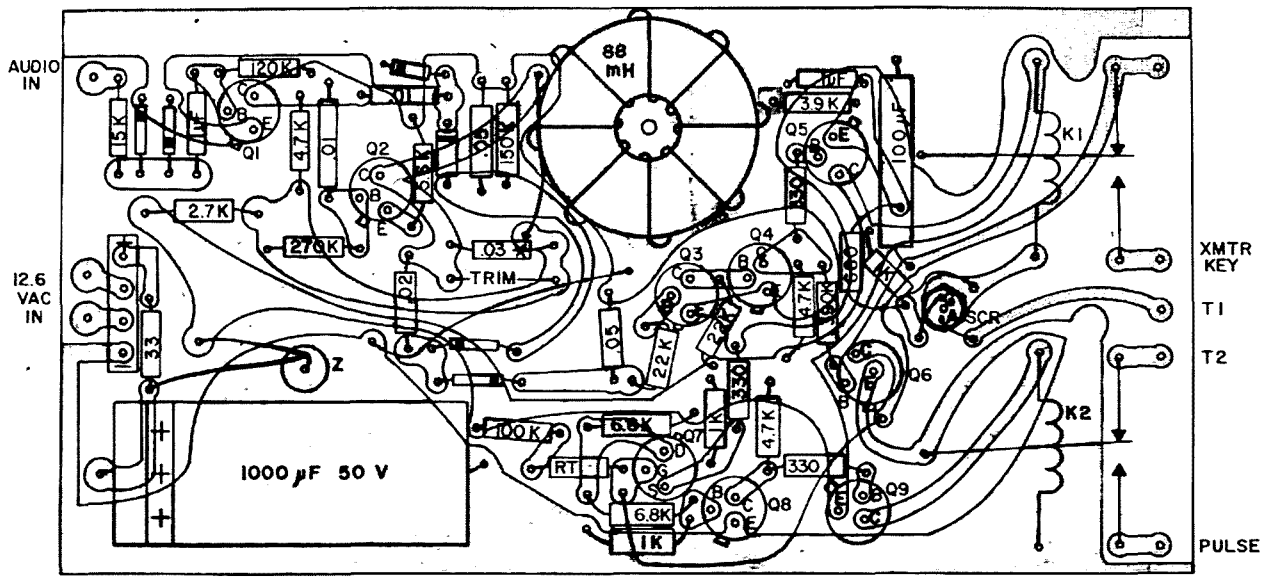


Fig. 3. Short tone burst decoder parts layout.

an N-Channel FET. With Q7 off, Q8 conducts causing normally conducting Q9 to cut off and release K2 momentarily. A short pulse to ground is one result which can operate the time out function, and at the same time the cathode of the Thyristor is momentarily broken with the other relay contact resetting the entire circuit.

Rt (at Q7)	TIME
1.2m	45 sec.
820K	30 sec.
390K	15 sec.

OR: use a 5M variable for 0–2 min.

Should a new pulse be received during the 45 second time down, Q6 switches on providing a fast discharge path to the timing capacitor without dropping out any relays. The general operation then is that the unit will remain on "until 45 seconds after the very last pulse is received." This is a convenient feature for repeater applications as the time of the tone burst can be very short and can be accomplished anytime during the time out period. As can be seen, there is also a degree of fail safe features which protect "stick-on."

Printed Circuit Board

After initial check out, I was concerned that no component would overheat or be in a "marginal state of operation." Long life and dependability were foremost. As can be seen from the photograph as well as the schematic, all components fit snugly on the board with only two over the top cheat wires used. My pc skills are still on the bottom of the learning curve. The board also includes a zener regulated power supply. Any great variation in supply voltage will of course affect the time period and this was considered a must under poor power regulation conditions experienced with repeater outposts. The total dissipation of the unit is 25 mA during standby and about 45 mA during time down.

This small dependable unit was used to control a wire-line controlled transmitter. It was a back-up system to dc control in the event the line would become shunted to ground (not necessarily interrupting audio) the "Phantom" control method might fall out. By preceding each control with a short tone burst, the circuit activates and is paralleled across a normal control relay. If the control relay fails to operate, the decoder takes over. If the relay does operate, the reset function "makes" and the decoder is made to reset at once.

There are all sorts of fancy applications possible with this unit and it is hoped that by making something a bit more simple to understand you will want to take a ham break and build something to amaze your neighbors with your resourcefulness.

. . .W3JJU

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A UNIVERSAL IF AMPLIFIER FOR A STANDARD OR PANORAMIC RECEIVER

The key considerations of good receivers are: high selectivity and image rejection; high overload – low cross modulation; and low noise factor.

If you built your own receiver, it also has to be rather easy to put it together and align it.

The described i-f amplifier uses two crystal filters in order to give 500 Hz and 5000 Hz bandwidth. It requires no alignment work, is uncritical to assemble and provides a high image rejection in standard receiver systems due to the operation at 9 MHz.

The gain is 46 dB and it can take.5 volts across the input terminals before cross modulation starts.

You can choose between the 500 or 5000 Hz bandwidth simply by actuating a dc switch.

Using the i-f amplifier in a standard receiver.

Although the intended prime application for this i-f unit is a panoramic receiver for two meters, you can build a standard receiver

The tuner and mixer and local oscillator units can be built in a standard manner. The i-f amplifier described follows the mixer stage, and no AGC is required because of the large signal handling capability. As usually done, AGC should be applied to the rf and also to the second part of the i-f amplifier. This second i-f amplifier does not require any selectivity and provides simply the additional gain needed to drive the detector. Any of the recent op amps or wideband amplifiers that meet the gain bandwidth characteristics may be used.

How to build a panoramic receiver.

This amplifier is ideally suited for VHF panoramic receivers. Figure 2 shows the detailed block diagram. The gain of the rf

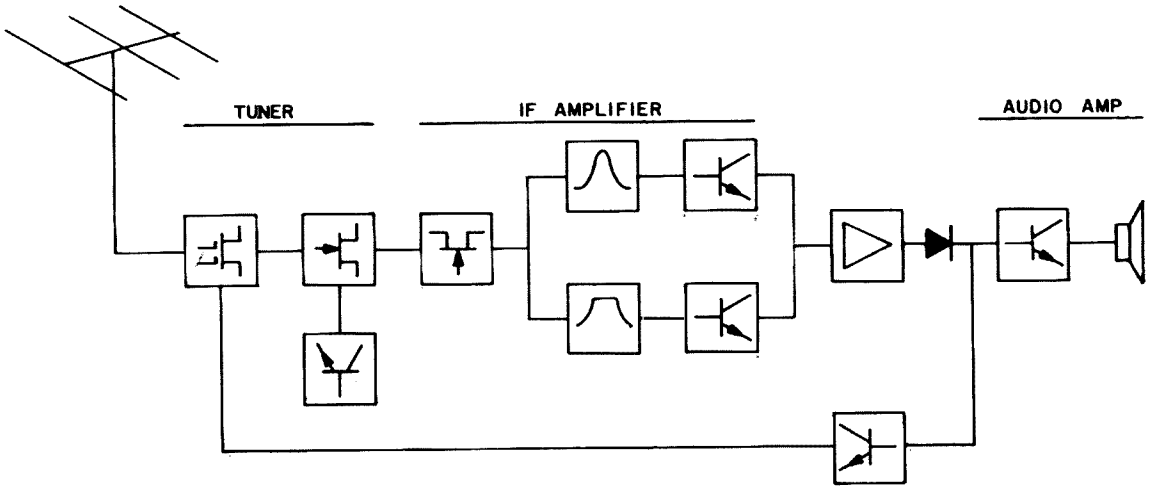


Fig. 1. Standard receiver block diagram.

amplifier and the mixer should be kept relatively low and not exceed some 15 dB in order to prevent overload of the following stages. In panoramic receivers AGC is not recommended, so al stages preceding the selectivity block must have extremely good signal-handling capability. The gain partitioning among the different functions of the receiver has to be made carefully.

The input signal passes the input attenuator which can be a passive and frequency-compensated resistive network. One can also use a dual gate MOSFET as rf amplifier and use several "preset" two voltage gates in order to provide fixed attenuation levels of say 0, -10, -20 and -30 dB.

The mixer should use FET for better cross modulation and low noise performance.

The local oscillator unit consists of the VFO, operating from 21–23 MHz, and an X-tal oscillator at 131 MHz. The oscillator mixer is followed by a band filter to provide the oscillator frequency of 153–155 MHz.

The attachment provides a simple sawtooth driver circuitry using unijunction tran-

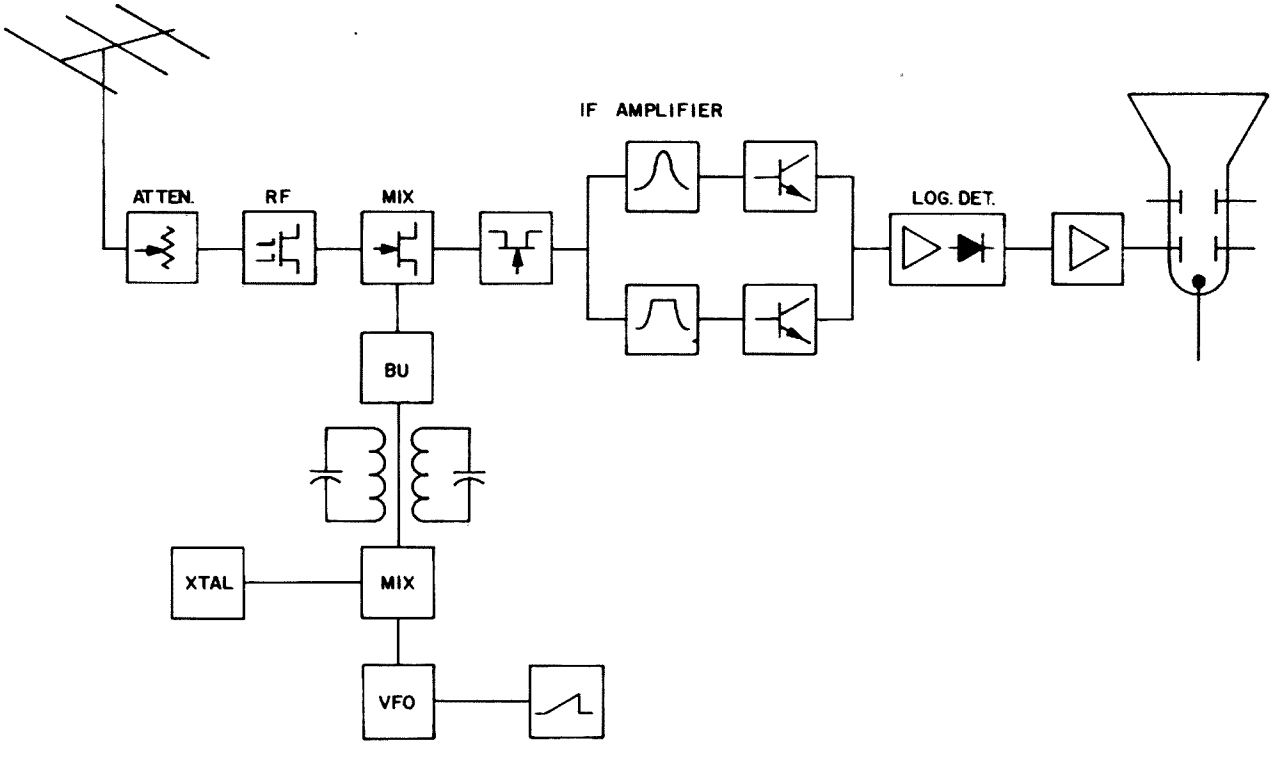


Fig. 2. Panoramic receiver block diagram.

sistor and FET, and the 21 MHz local oscillator using varicaps.

The i-f signal coming from the tuner is fed into the described i-f selectivity and gain block which is followed by a logarithmic amplifier. This logarithmic amplifier can be made by using operational amplifiers combined with diodes or transistors in the feedback path in order to simulate logarithmic characteristic. The dynamic range of this amplifier should be 50 to 60 dB

The two different bandwidths allow: a) scanning of the whole 2m band with a (sawtooth) sweep frequency of 15 Hz which is, depending on the used display tube, just above the level where the flicker effect becomes negligible (the bandwidth in this case is 5 kHz); and b) scanning a section of the whole 2m band and obtaining a high resolution. The bandwidth for this is 500 Hz. This small bandwidth allows an accurate analysis of the signal for instance to determine the modulation depth, the bandwidth, the sideband symmetry, etc.

The i-f amplifier unit.

The complete amplifier is shown in Fig. 3. It consists of a periodic FET preamplifier, the solid state bandwidth switch section, the two crystal filters, and the post amplifier which provides most of the total gain of the whole amplifier. The purpose of putting an FET as amplifier ahead of the filter and the switch is to achieve a high signal/noise ratio and to overcome the losses of the filter and the switching arrangement. Also the FET can withstand high signal levels without causing distortion, especially if the device is operated in common gate mode.

Generally filter losses are in the order of 1 to 4 dB depending on the selectivity and frequency of operation and any losses ahead of an amplifier add directly to the system noise figure.

Other advantages of a common gate mode FET are: a) low input impedance – no tuned circuit is required. In most cases tuner and i-f amplifier are separate "building blocks" which are physically separated. They normally are interconnected by a low

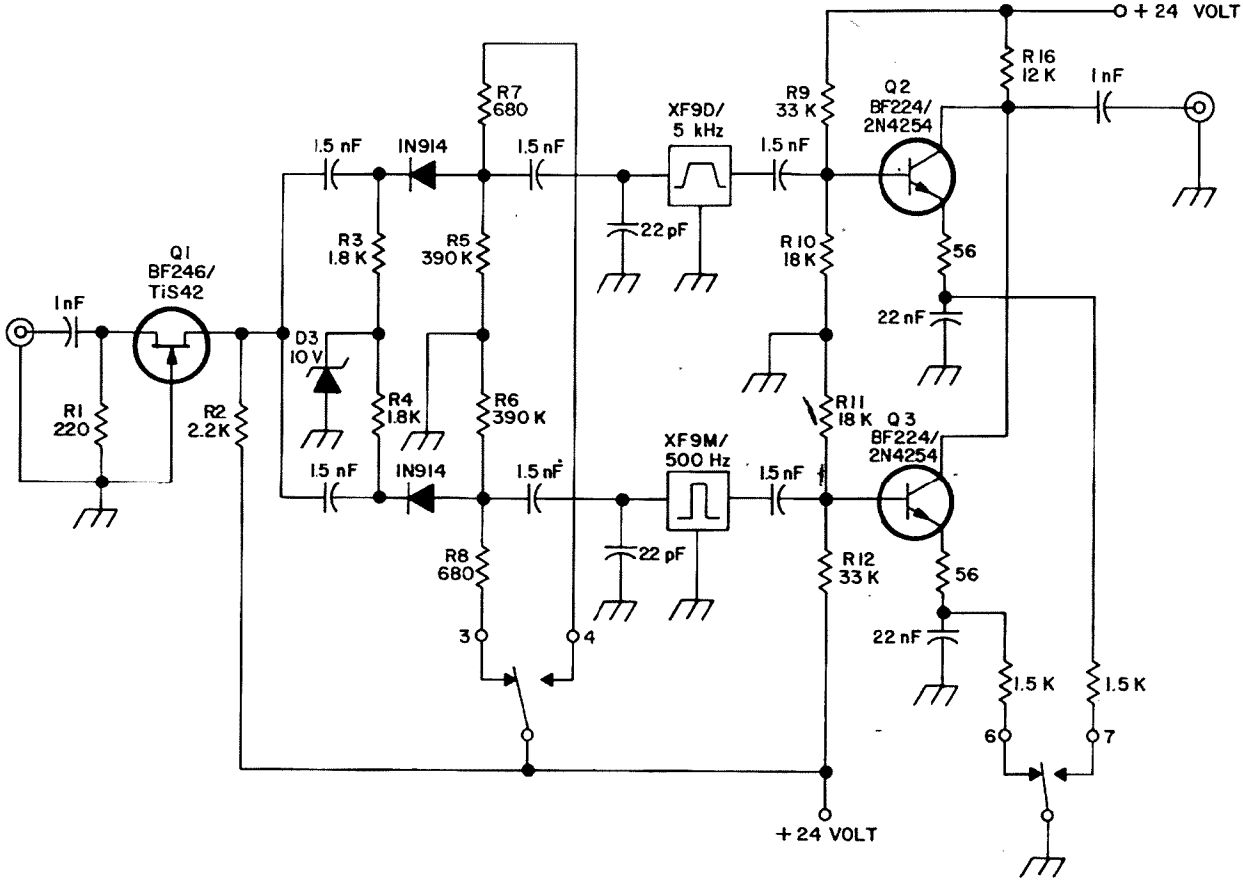


Fig. 3. i-f amplifier circuit diagram. Note that a few capacitance values are given in nF. 1 nF = 1000 pF = .001 μF.

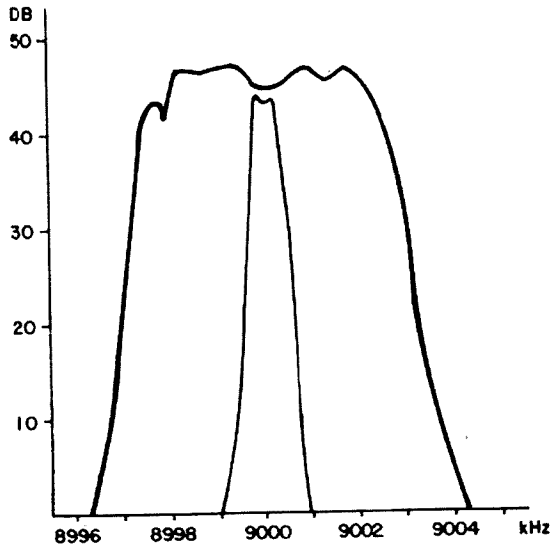


Fig. 4. Amplifier filter response curves.

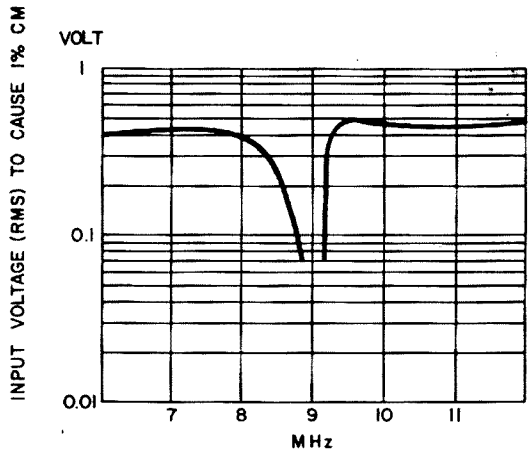


Fig. 6. Cross-modulation performance curve.

impedance coaxial cable. b) The stability of an FET in common gate is excellent. and c) The biasing is extremely simple, the gate of Q1 is tied directly to ground and only R1 of 220Ω is needed to set the drain current at approximately 8 mA.

The voltage gain is Vu = Yf x RL where RL is the equivalent parallel resistance of R2, R7 and R3 respectively, R2, R4 and R8.

The selectivity and bandwidth is switched from 500 Hz to 5000 Hz by the two switching diodes D1 and D2. If D1 is switched on, by applying a positive supply voltage to the terminal 4, D2 is automatically reverse biased by -10 volts due to the zener diode, D3, and the biasing resistors R4 and R6.

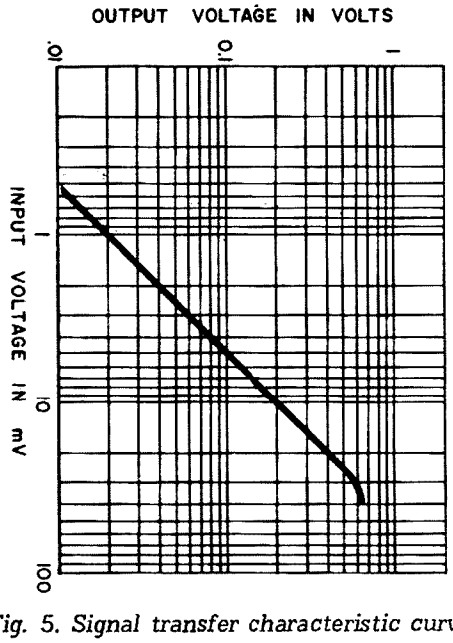


Fig. 5. Signal transfer characteristic curve.

The passband characteristic is very sensitive to the matching conditions and both filters are matched at the input and output terminals to see 500Ω and a parallel input capacitance of 30 pF.

The actual filter response is shown in Fig. 4. The two curves were taken across the input and output of the amplifier unit. The flatness is only 1 dB for the 500 Hz and 3 dB for the 5000 Hz filter.

Q2 and Q3 are individual amplifier stages for the two filters. Using individual amplifiers adds significantly to the channel separation. D1 and D2 are switched on for the 5000 Hz channel, while D3 and Q3 are in the off stage and vice versa for the 500 Hz channel.

The voltage gain is 46 dB and the output swing is linear up to 5.5 volts RMS. This corresponds to an input level of 27 mV. The transfer characteristic of the amplifier is given in Fig. 5 while the cross modulation performance can be seen in Fig. 6. The measurement condition for this test were set as follows: the desired signal is 1 mV across the 50Ω input terminal. The undesired signal was 100% modulated. The undesired signal to produce 1% cross modulation is plotted as a function of the frequency deviation. The graph shows that cross modulation only occurs at input level of 400 to 500 mV RMS. If one uses a 16 db tuner, the input level can be as high as 83 mV at the antenna terminals.

. . .DJ1SK

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TOUCHTONE AND TELEPHONE CONNECTING ARRANGEMENTS

Until recently, auto-patch connections to the telephone lines have been on the shady side. Most hams prefer touchtone. Bell Telephone has approved tariffs for the use of customer-provided tone address signaling (touchtone dialing). Bell's "automatic voice coupling arrangement" type C2ACP must be used. It is available for $10 installation and $3 per month.

This coupler is a two-way device providing the customer with a contact closure when ringing is received, with a control lead to seize or operate the coupler, with limiting and isolation to protect the telephone network, and with dialing connections if touchtone is not available. It is worth the effort and price to have a legal patch that can be shown to anyone.

Figure 1 shows it connected to WA3IGS repeater/auto-patch. All leads are designed on the diagram.

Bell Telephone will provide you with a Technical Reference #PUB42207 when you order the coupler, if you request it. It gives full details of operation and interconnections.

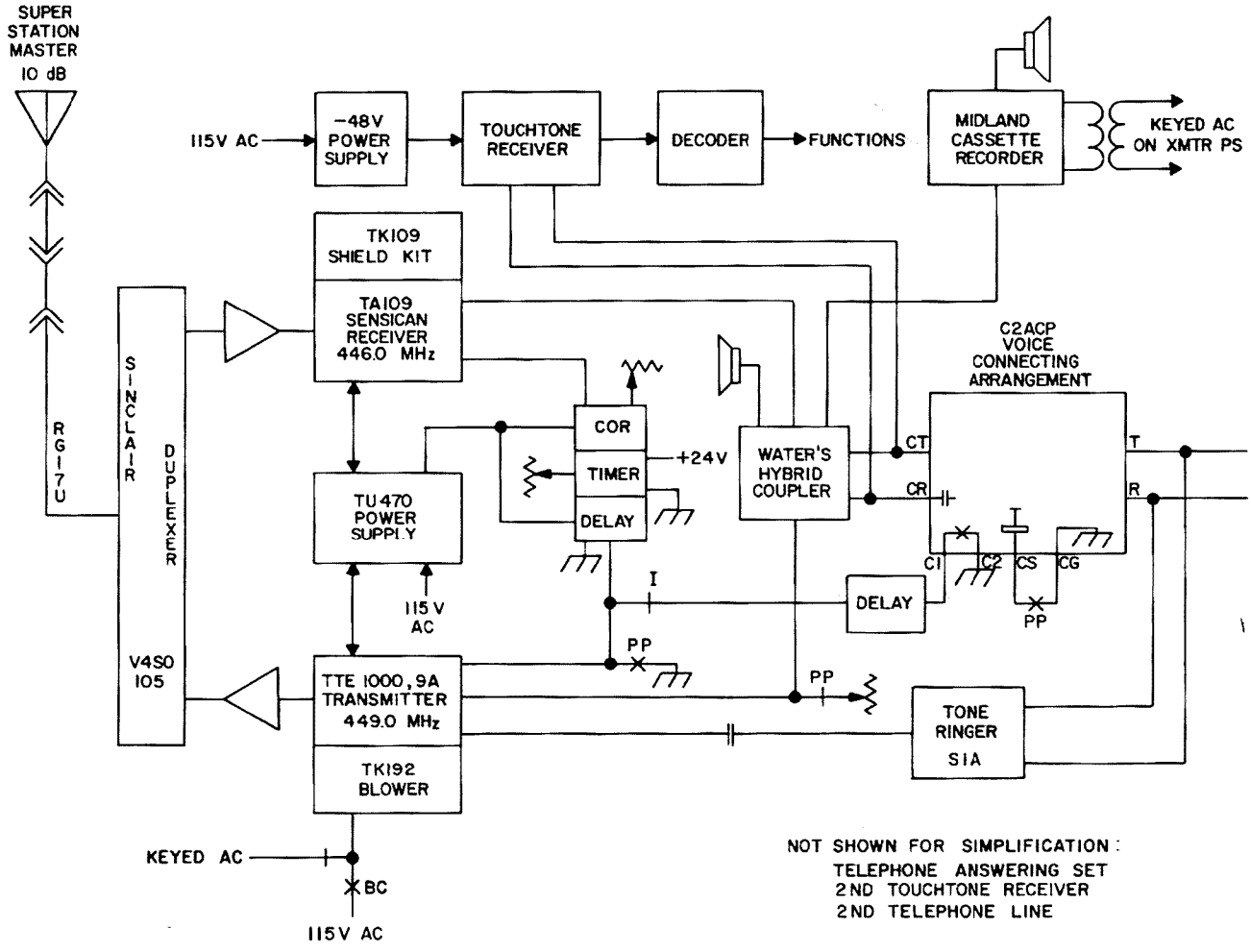
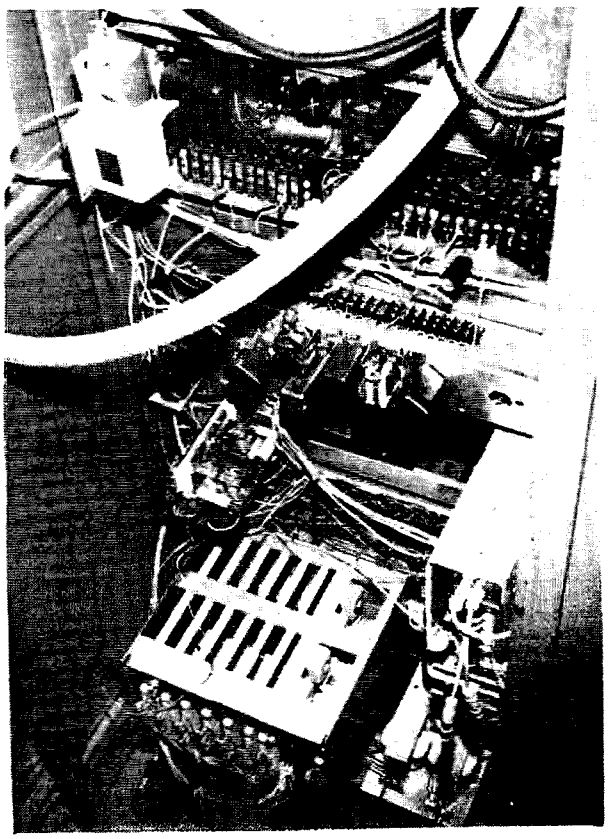


Fig. 1. Block diagram of the WA3IGS auto-patch repeater.



Touchtone dial mounted on the front of a HT series handie-talkie.



Rear view of the WA3IGS repeater showing the A3 Touchtone decoder.

Pads

Touchtone pads for the auto-patch are readily available from many suppliers, including Greybar in Philadelphia and Stromberg Carlson in Rochester, New York. The 35A3A type dial (ITT #3200G450) is available from Greybar for about $21. The Trimline miniature dial type 82A2A is available from Stromberg Carlson for about $24. These are identical to Western Electric types. Both are the 12-button version.

The picture shows the Trimline dial mounted in a minibox and attached to a Motorola H24DCN HT. This makes a neat portable telephone that even AT&T envies. The 11 and 12 buttons are used to enable and disable the patch. If you are afraid to drill the HT cover, you can order another from Spectronics at a very reasonable cost and drill it up. The Trimline is not limited for use to the HT series. It will work just as well with any other FM rig. Figure 2 shows the Trimline schematic and its connections.

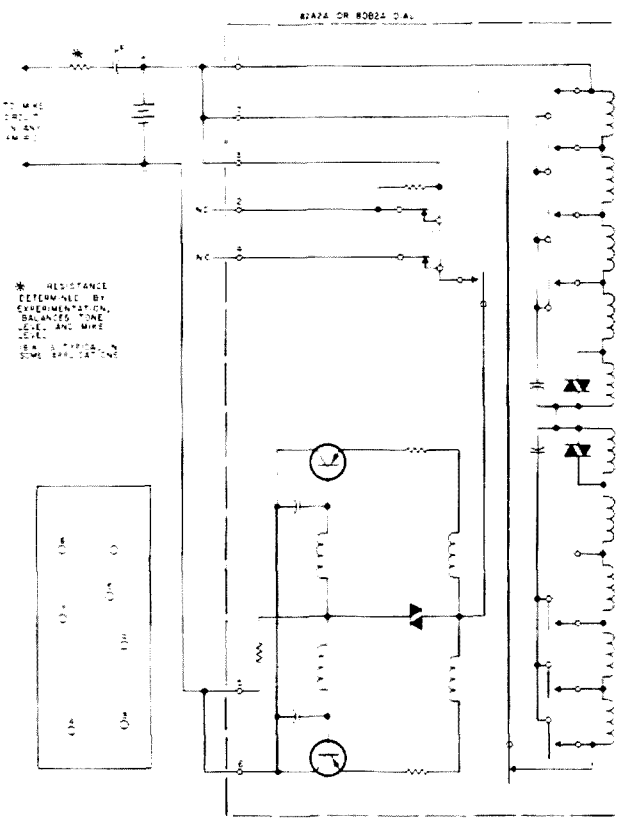


Fig. 2. Trimline schematic and its connections to an FM rig.

Decoders

Touchtone receivers are needed in a

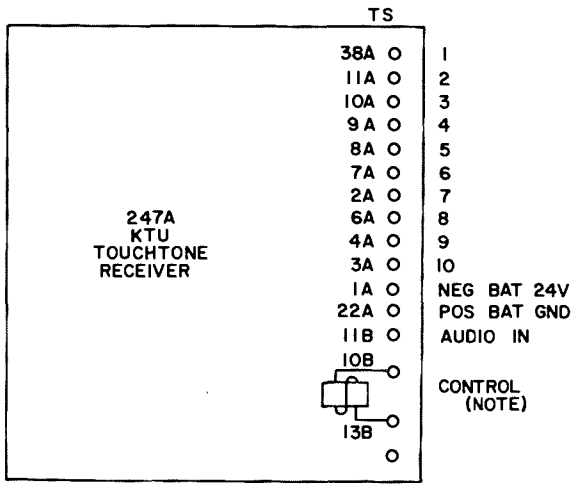


Fig. 3a. Connections for the 247A Touchtone receiver.

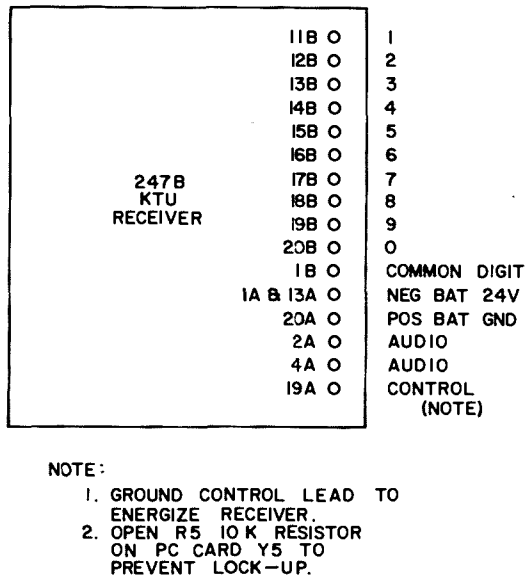


Fig. 3b. Connections for the 247B Touchtone receiver.

touchtone auto-patch system to enable or disable the system. Basically, they are nothing more than 7 or 8 tone receivers (L-C circuit preceding an amplifier) with logic connected to the output. Although they are relatively easy to build, most hams prefer to scrounge one of many types available.

One source is Digitone in Ohio. They also offer many other items useful for auto-patches. Other sources included Stromberg Carlson and various surplus houses. Western Electric no longer sells outside the Bell system.

Many types of decoders are available. The 247A and 247B types are used primarily on customer intercom systems. The A3 is a standard Central Office decode. Hundreds of A3 types are either floating around or

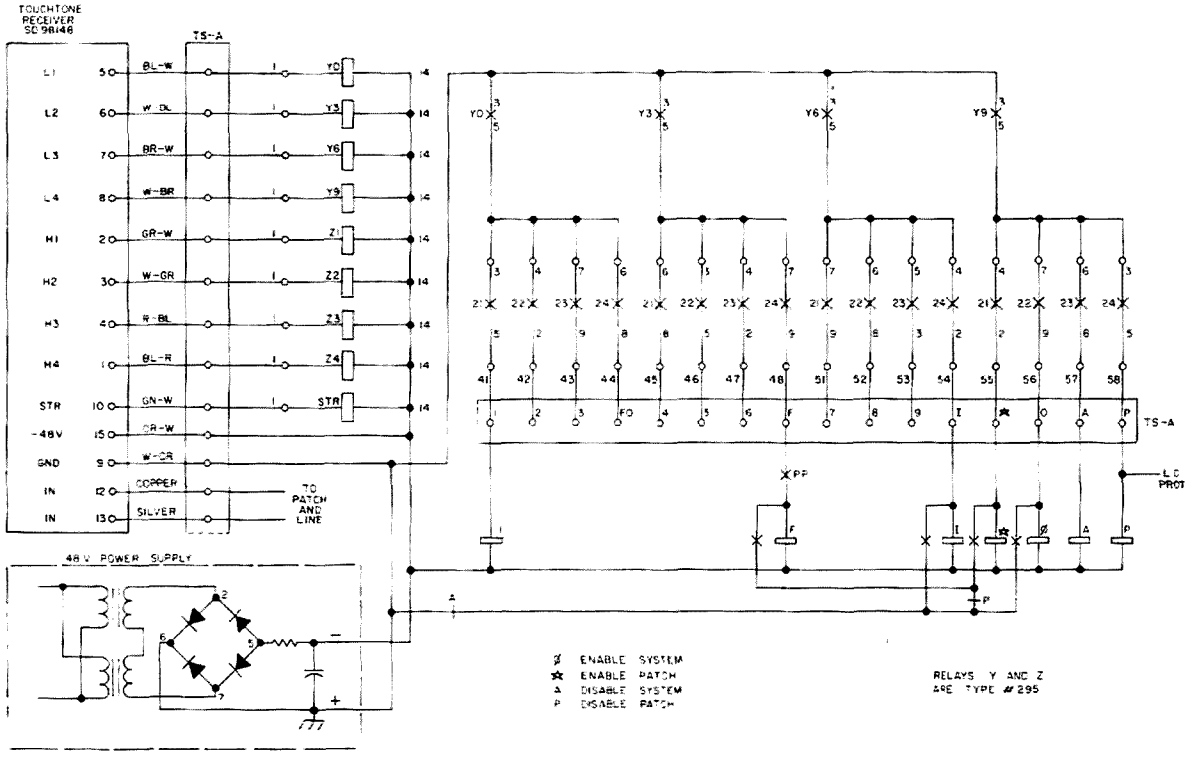


Fig. 4. Connections for the SD98148 receiver.

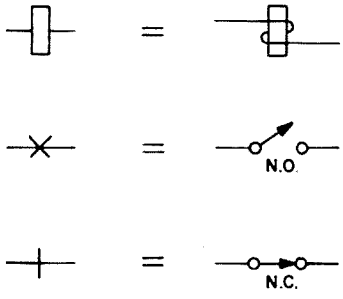


Fig. 5. Legend for the connection diagrams.

smashed as a result of changing the military Autovon Network from 4 wire #5 crossbar to electronic switching. These were 16-button decoders which had one additional tone (4 digits). Out of 73 decoders from a Philadelphia military exchange, only 16 could be saved from the sledgehammer. AT&T felt that this was enough, since previously released equipment showed up in commercial service again in another area. That's what happens! Others were released in other areas, so keep your eyes open. Please don't ask for any from this area. They are all in use.

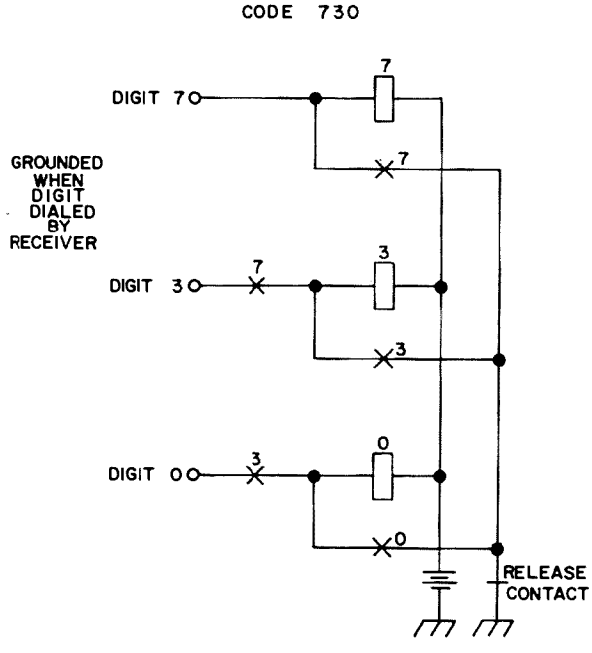
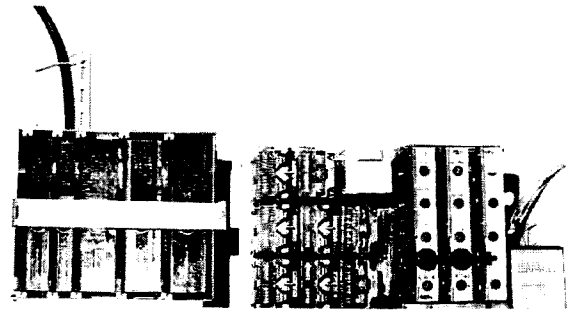


Fig. 6. Simple circuit for converting digits to functions.



The 247A and 247B Touchtone decoders.

The photo shows the 247 A & B types. Figures 3, 4 and 5 show hook-up connections to get them operating. Figure 6 shows a simple circuit for converting digits to functions. There is no limit to building out the codes.

Protection

Protection for auto-patch long distance calls is simple. The Bell system has in most areas the prefixing of digit 1 for toll calls. A gate that detects dial tone (350 and 440 cycles) and the digit 1 at the same time simply disconnects the patch. See Fig. 7 for an example. In the event you want protection and you don't have dial 1 prefix, you can actually decode entire telephone numbers or the first 3 digits and kill the call if the number dialed is other than what's in the program. Your tape recorder log is your best insurance policy.

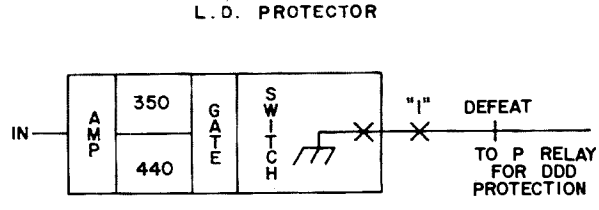


Fig. 7. Protection circuit to guard against toll calls.

Conclusion

Since no two auto-patch systems are the same, I have generalized in some areas. Every one has his own way. Anyone desiring schematics of WA3IGS may have them upon supplying a self-addressed, stamped envelope and cost of reproduction. It took three of us to get this system working properly over a three-year period. I recommend this type of system only to skilled organizations and not as an individual's private system.

. . .K3DSM

Harold Balyoz W6YBP
5651 Hesperia Avenue
Encino CA 91316

THE SIMPLEST AUDIO IC YET!

Audio Output IC's have been coming out thick and fast. Practically every IC manufacturer has one in his catalog. However, my choice for simplicity, performance, and lowest parts count is National Semiconductor Corporation's LM380N.

Just look over Fig. 1. Would you believe just six parts plus heatsink and battery? And it's a dandy! It is rated for 2 watts output at 18 volts. Mine has put out over 2½ watts with 18 volts, and just over one watt at 13 volts. Since it can take 22 volts without damage, yet still work at 8 volts, it is perfect for mobile use without any worries about either weak or overcharged car batteries. The output looks very clean on a scope and the manufacturer rates the typical total harmonic distortion at only 0.2%. Quiescent supply current is only 7 mA at 18 volts and bandwidth extends to 65 kHz. (It was really designed for a simple, high quality record player system. Two LM380N's, a ceramic stereo cartridge, two speakers, and the result, easy stereo!

In connecting it up, pin 7 is the official negative connection for the power supply. However, since it needs about six square inches of copper clad board for a heatsink, I soldered pin 7 along with heatsink pins 3, 4, 5, 10, 11, and 12 right to the foil side of a copper clad printed circuit board 2" x 3" square. The rest of the components were soldered to insulated terminals bolted to the board. The 5 μF capacitor from pin 1 to ground reduces ripple, but the circuit works even without it!

The price for the LM380N is only $2.25 each when you buy one at a time; really a bargain!

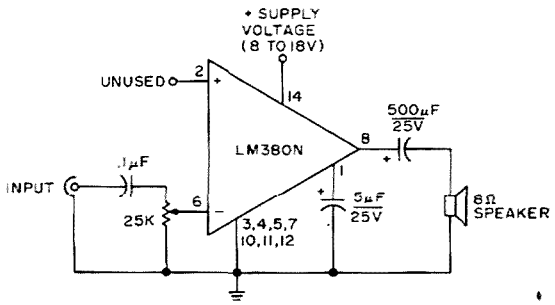


Fig. 1. The simplest audio IC yet.

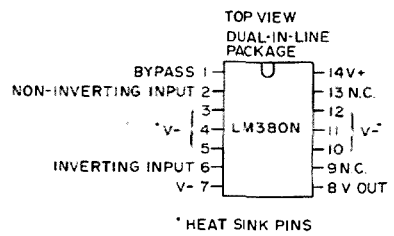


Fig. 2. Top view, dual-in-line package.

Figure 2 shows the pin connections viewed from the top of the IC. You can bend the heatsink pins to lay flat on the board before soldering and bend the others up, away from the board for connection to the rest of the circuit. If you solder to the IC quickly with a hot iron, no damage will result as the lead temperature is rated at 300°C for 10 seconds during soldering.

You can bet that my unit is going to be the beginning of a tiny SSB receiver for portable and mobile operation.

. . .W6YBP

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TUNING TIPS FOR USING VOLTAGE VARIABLE CAPACITORS

The use of inexpensive varactor diodes to provide linear and versatile tuning schemes for homebrew oscillator projects is described in detail. The information is applicable to circuits for HF transceivers as well as those for VHF equipment.

Voltage variable capacitors or varactors have been available, basically, since transistors were used. The base-collector junction of many transistors (one example is the 2N3565), as shown in Fig. 1, can be used to form a voltage variable capacitor usable over a range of 10–15 pF.

The effect of having a diode junction, either as part of a transistor or as a separate diode, forming a capacitance which varied as the voltage impressed across the junction, was supposedly discovered by accident rather than by any scientific research aimed in that direction. At any rate, varactor diodes specifically meant for use as voltage variable capacitors are now available in a large range of capacitance values from many manufacturers at very reasonable prices. It is rather surprising, therefore, that so few amateur equipment designs employ these diodes and rather stick to old-fashioned air variable capacitors. Hopefully, the material presented in this article may assist various

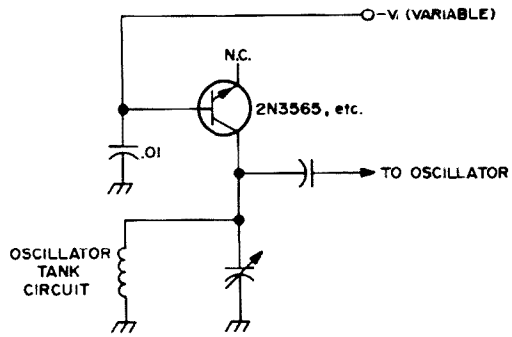


Fig. 1. Transistor diode junctions can serve as varactor diodes. Several receivers/transceivers have used such schemes for incremental tuning.

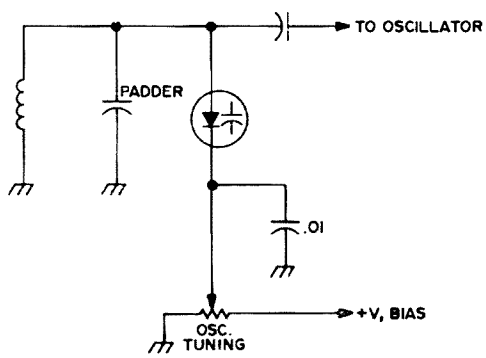


Fig. 2. Basic use of tuning diode. One side of diode is dc grounded through the oscillator tank coil.

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readers to more easily utilize these very useful diodes.

Particularly for the tuning of oscillator circuits, varactor diodes when combined with the proper type of potentiometer control offer tuning possibilities and variations which would be impossible, or at least extremely difficult and costly to achieve, using conventional air variable capacitors and mechanical tuning systems. A number of examples are presented later which illustrate the various tuning possibilities possible with varactors. A good basic understanding of what varactor diodes can do and what their specifications mean is, however, basic to successfully using these diodes.

Basic Operation

Varactor diodes as voltage variable diodes function basically on the idea that when a diode junction is reverse biased with an increasing voltage potential, its depletion region increases and its capacitance value decreases. The increasing potential can be viewed as pulling the plates of a capacitor further apart and thus decreasing its capacitance. The usage of such a diode in a simple fashion as the tuning capacitor for an oscillator is shown in Fig. 2. The diode is tuned by the potentiometer which, since it controls only the dc voltage impressed across the diode, may be located at any distance from the diode. The dc ground return for the other side of the diode is made through the grounded end of the oscillator coil. The whole scheme would be almost ideally simple if it were not for the fact that the diode's quality as a capacitor (Q) depends upon the frequency of operation and the diode's capacitance variation is not directly related to the rotation of the potentiometer arm.

Practical Diodes

The varactor diode usually does not exhibit a linear capacitance variation with applied voltage, although there are some variations to the general rule. Usually a diode exhibits a capacitance variation which varies as some exponential relationship with the applied bias voltage. Diodes are usually classified by their nominal capacitance value at some reference bias voltage. For instance,

the graph of Fig. 3 shows a "47 pF" diode, the capacitance value which it has at a reference bias voltage of −4V. The capacitance range of the diode, a 1N3628, is actually from 25–125 pF. The capacitance variation is shown by the graph and is characteristic of diodes produced by many manufacturers. Unfortunately, the capacitance variation is not linear or logarithmic with the applied bias voltage and no potentiometer taper is available which will directly provide a linear capacitance variation with linear rotation of the potentiometer shaft. A number of ways can be employed, however, to correct this situation as described shortly.

Figure 4 shows the capacitance versus bias voltage curves for two diodes which have a capacitance range that many amateurs would find useful in building oscillators for the HF frequencies. The 1N3627 is classified as a 22 pF diode (at 4V bias). Its useful capacitance range is from 12 pF (at 20V bias) to 50 pF (at .1V bias). The BB103 is a European type made by Siemens and available here. Its capacitance is quoted as 29 pF (at −3½V bias) and its effective capacitance range is from 13–52.5 pF. The two curves are shown to illustrate how the characteristic curves of two diodes from different manufacturers can vary slightly. If one wanted to build an oscillator, for instance, with a very linear readout it is a good idea to obtain the characteristic curve of the diode family from a manufacturer.

Just to illustrate the interesting types of varactor diodes which are available for tuning purposes, Fig. 5 shows an unusual dual diode made by Siemens, the BB107. The diode costs around $5 and is designed primarily for use in AM receivers. The diodes have a common anode connection and the capacitance of diode section D1, for the same bias voltage, always has a capacitance a fixed amount different than that of the other section D2. The graph illustrates this variation. Such a diode could have some very interesting application for oscillator tuning. Operated over a smaller capacitance range than the total available, the diode exhibits an almost perfectly linear capacitance variation with bias voltage. By switching from one diode section to the other in a properly set up oscillator circuit, one can switch back and forth between the CW and phone portions of a band. For a LF converter, the diode can be used exactly as it was intended – one diode section controlling the tunable oscillator and the other the input tuning to a mixer stage.

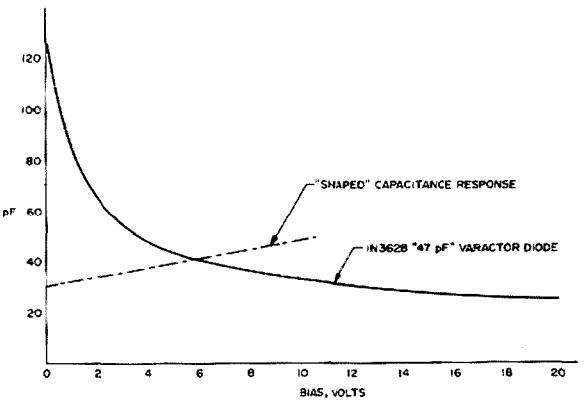


Fig. 3. Response of a typical "47 pF" tuning diode (solid line).

As with many electronic components these days which are a bit advanced, the question of availability often becomes a problem when one finally decides to build a piece of equipment. Unfortunately, only a very few varactors designed for voltage tuning usage as capacitors have standard 1N numbers. Most cannot because the capacitance/bias voltage relationship varies from manufacturer to manufacturer and the assignment of 1N numbers implying interchangability would not make sense.

One "family" of varactor diodes that should have special appeal to amateurs is the Motorola MV2000 series. The available types are shown in Table 1. They are available from any large distributor of Motorola semiconductors (Allied Radio, for instance) at only 90¢ each. The diodes will have a capacitance curve similar to that shown in

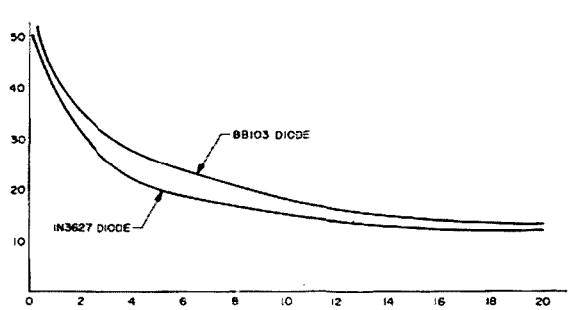


Fig. 4. Response curves of two typical 22–29 pF labeled diodes.

Table I

Type	4V Capacity	Q (50 MHz)	Tuning Ratio (2–30V)
MV2101	6.8	450	2.7
MV2102	8.2	450	2.8
MV2103	10	400	2.9
MV2104	12	400	2.9
MV2105	15	400	2.9
MV2106	18	350	2.9
MV2107	22	350	2.9
MV2108	27	300	3.0
MV2109	33	200	3.0
MV2110	39	150	3.0
MV2111	47	150	3.0
MV2112	56	150	3.0
MV2113	68	150	3.0
MV2114	82	100	3.0
MV2115	100	100	3.0

Motorola MV2000 varactor diode family. At 90¢ each, these diodes should appeal to many amateurs.

Fig. 3 but one can always send to the manufacturer for the specific curve for any diode *(Motorola Semiconductors, McDowell St., Phoenix AZ 85001)*. The tuning ratio refers to the capacitance variation between the bias voltage stated. This drops as the capacitance value increases but any of the diodes would be suitable for HF application. The smaller capacitance diodes would still be useful into the VHF range. If the Q is 300 at 50 MHz, it would drop to 30 at 250 MHz, etc. Table II shows the essential characteristics of the smaller family of diodes available from Eastron Corp. at $1.50 each (except for the VC6204 which is $1.80). Eastron will sell directly to amateurs, postage prepaid. Write to *Bill Slusher, WIZYX, Eastron Corp., 25 Locust St., Haverhill MA 01830.*

Shaping the Capacitance Variation

Suppose one wanted to construct a really good 5 MHz oscillator for use with an existing transceiver so one could achieve independent receiver and transmitter tuning. Many transceiver manufacturers offer such separate oscillators but unfortunately their cost runs easily over $100 and can represent a significant fraction of the original transceiver cost. Building such an oscillator as a home-brew project can represent a very cost-savings project and yet not lead one down any too difficult paths. Also, there is no danger of incorrect operation on out-of-frequency segments of a band because the home-brew oscillator is only used for receiver tuning.

By searching through past issues of various amateur radio magazines one can find many excellent circuits for transistorized 5 MHz oscillators. One can also of course just duplicate the circuitry of the oscillator found in an existing transceiver, if the oscillator appears stable enough. Duplicating the actual circuitry of an oscillator usually presents no great problem. The problem develops when one considers how to duplicate the mechanical tuning aspects of the oscillator where a dial mechanism allows linear readout to 1 kHz segments, etc. The use of varactor diodes can greatly simplify this problem if one can develop the oscillator circuits such that the oscillator frequency as a function of bias voltage applied to the varactor diode used to tune the oscillator has a linear relationship.

The simplest case is if one chooses an oscillator circuit where the frequency output is linear with the capacitance variation of the capacitor used to tune the oscillator circuit. In this case, the varactor diodes capacitance variation has to be linear with the bias voltage change applied to it. There are two ways to achieve this effect. The simplest is to vary the bias voltage across the varactor only over a range over which the capacitance variation remains linear. For instance, in Fig. 5 varying the bais voltage from −10 to about −4V produces an almost perfect linear capacitance variation. Varying the bias voltage over a smaller range of from −10 to −8 or to −6V in Fig. 4 produces a similar linear effect but the capacitance variation is rather small and would only suffice for oscillators designed to cover a 100–200 kHz segment of a band at a time.

The second way to make the capacitance variation of the diode linear with applied

Table II

Type	4V Capacitance	20V Capacitance	Q (30 MHz)
VC6204	4pF	2 pF	60
VC6233	33	17	60
VC6156	56	29	60
VC6299	100	55	60

The smaller but interesting varactor diode selection from Eastron Corp. Diodes may be ordered directly from the manufacturer (see text).

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bias voltage when it is not inherently so is to use a voltage shaping network for the applied bias voltage. As was mentioned before, the voltage versus capacitance variation of a diode does not match the taper of any potentiometer. Therefore the shaping network must be arranged to use a linear taper potentiometer with an auxiliary network to change the bias voltage at points where its linear variation deviates too far from the non-linear variation of the diode's capacitance/bias curve. In essence, one tries to match a number of straight line segments to the changing curve of the diode characteristic.

The procedure is not difficult especially if not too great a capacitance range is desired. A simple example will be used to illustrate the point. For instance, if the diode shown in Fig. 3 was desired to be used such that its capacitance change with bias supply voltage change (as supplied by a linear taper potentiometer) was desired to be linear over the approximate capacitance range of 30–50 pF, the shaping circuit of Fig. 6(A) is used. The diode has to be biased from both "sides" rather than having one side grounded because the capacitance variation of the diode changes most rapidly at low bias voltages *across* the varactor diode. This point will become clear if one follows through on the example. With the circuit shown and until the variable bias voltage exceeds 6V, the 6V fed through a switching diode can be considered to be out of circuit. So, as the variable bias voltage varies from 0 to about 6V, the voltage across the varactor is 12V (fixed bias values minus the variable voltage). The capacitance can be plotted as shown in Fig. 3 (dashed line). In this case, the "bias, volts" line on the graph represents the value of the variable bias voltage and *not* the voltage across the diode. When the variable bias voltage exceeds about 6V, the diode in the 6V bias line is forward biased and conducts. As the variable bias voltage now increases, its rate of change is determined by the voltage divider network formed by the two 100K resistors. The bias voltage across the varactor diode for any given value of the variable bias voltage can be found by simple ohm's law calculations

(remember that the varactor diode is never conducting). The plot of variable voltage versus capacitance is shown by the dashed line in Fig. 3 and found to be quite linear.

The bias voltages shown in Fig. 6(A) may appear numerous but they are all easily obtained from one supply using dropping resistors and zener regulators. The shaping network values can be determined by trial and error to obtain the most linear response. As an approximation for the intermediate bias value (6V in Fig. 6(A)) take the bias voltage necessary to achieve a mean capacitance value for the total capacitance range desired. In the example, the total range was 30–50 pF, making 40 pF the mid value for which the required bias voltage (from Fig. 3 solid line) is 6V. The resistor in series with the variable bias voltage should remain 100K and one can then try differenct values for the resistor in series with the intermediate bias voltage to obtain the most linear response. A few plots on graph paper will quickly reveal the best value.

If one desired to make the capacitance variation linear with variable bias voltage over a larger capacitance range, it can be done by the circuit of Fig. 6(B). The circuit works on the same idea as the simple shaping network just described. It appears a bit more complicated but is actually quite economical since each intermediate bias voltage is obtained from one source via zeners. Extremely linear capacitance variation can be obtained over at least a 100 pF range, depending upon the diode involved.

Rather than describe in detail here the procedure for calculating all the bias voltage involved, it is suggested that the reader sent for Application Note No. 6 from Eastron Corp. If one has a capacitance measuring bridge, excellent results can be obtained by first making each bias voltage variable via a potentiometer from the main supply, measuring the capacitance variation for different settings, and then finally using zeners for the intermediate bias voltages.

Frequency Shaping

The above procedure has described how to make the capacitance change of a varactor linear with the variable bias voltage. However, one may have an oscillator circuit where the frequency output is not linear with the capacitance variation in the oscillator tank circuit to begin with. In this case, frequency shaping via the varactor diode bias can be done and, in fact, represents one of the major advantages of using varactor diodes for capacitance tuning. A linear *frequency* output can be obtained with a fraction of the effort required using elaborate mechanical tuning schemes, special oscillator coils and air variable capacitors, etc. This feature can also be combined with a very simple readout scheme for frequency settings.

Frequency shaping is obtained in basically the same manner as the linear capacitance method. However, in this case, a graph similar to Fig. 3 is drawn which represents oscillator output frequency (instead of diode capacitance) versus bias voltage supplied to the diode. The output frequency of an oscillator being built can be monitored on any available receiver or transceiver. Once the curve is drawn, a shaping network similar to that previously described is calculated so that the oscillator output frequency versus bias voltage applied to the diode has a reasonable linear

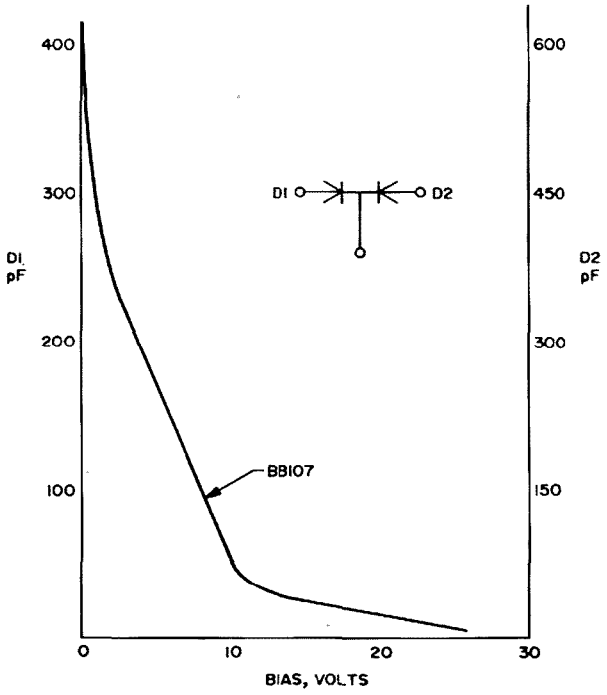
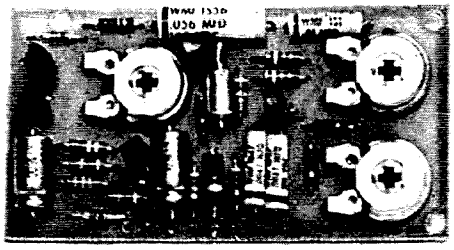


Fig. 5. Response of an unusual but handy dual tuning diode made by Siemens in Germany and available in the U.S.

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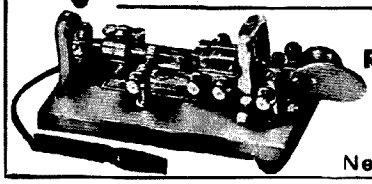
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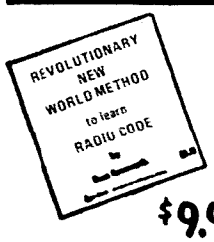
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relationship. The accuracy of the shaping network can always be corrected by monitoring on a calibrated receiver.

Once a linear relationship has been achieved between output frequency of an oscillator and bias voltage, tuning of the oscillator via variable bias networks, frequency readout, etc., are greatly simplified. The following paragraphs present only a few ideas. Many more can be developed depending upon individual requirements.

Tuning and Readout Systems

With a linear output frquency/bias voltage relationship for a varactor tuned oscillator, the tuning problem reduces itself to the simple rotation of the linear taper potentiometer which supplies bias voltage to the diode. If the potentiometer rotation through the usual 270° varies the oscillator frequency by 250 kHz, it can be driven via a simple 10:1 gear reduction drive. In this case, each degree of basic potentiometer variation covers 250/270 or .926 kHz per degree. The 10:1 drive means that each 360° rotation of a tuning knob provides 360/10 or 36° of basic shaft rotation. The frequency variation in this case would be 36° X .926 kHz per degree or about 33 kHz per tuning knob rotation. By using greater reduction tuning ratios or smaller basic oscillator frequency coverage (100 or 200 kHz segments), extremely fine tuning can be obtained which easily allows 1 kHz or less readout divisions on the skirt of a large tuning knob. An important consideration is that extremely fine bandspread can be obtained with reasonable gear reduction ratios for the bias potentiometer (10:1, 20:1, etc.) so that the gear reduction drives are both inexpensive and have minimum backlash. One can also switch the bias voltage to a tuning diode between a potentiometer driven via a gear reduction drive and a directly driver potentiometer to provide a fine bandspread tuning or a quick band-scan tuning. The extra cost is only that of a simple potentiometer and only single dc line voltage switching is involved.

Another approach not to be overlooked is that of using multi-turn potentiometers for bias voltage tuning. Such potentiometers,

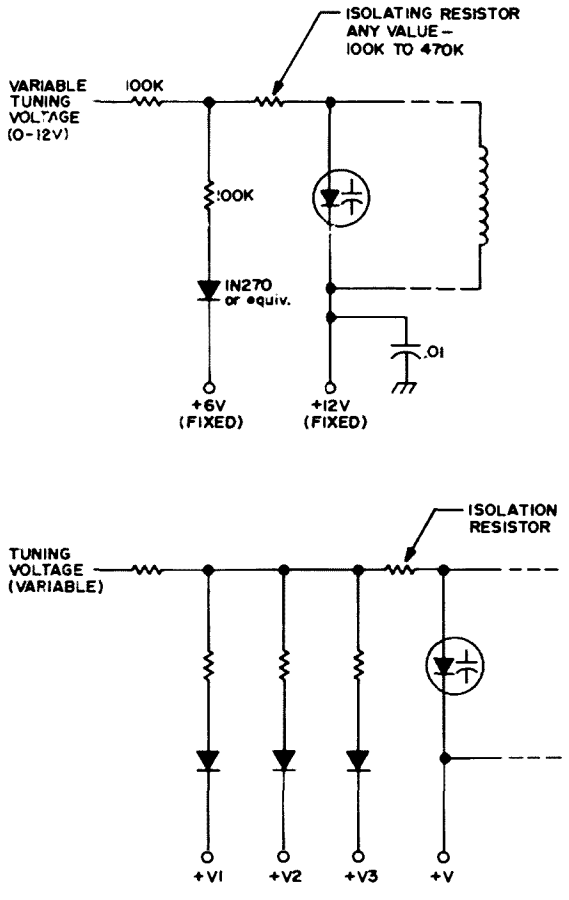


Fig. 6. Simple (A) and complex (B) shaping networks which can be used to "linearize" basically non-linear response of a tuning diode.

usually in the 10 turn variety, are available from a number of surplus outlets (Poly Paks) at a cost of only a few dollars. These potentiometers are of commercial quality and provide excellent resetability combined, of course, with their built-in fine tuning advantage. Such potentiometers when combined with even a simple gear reduction drive provide extremely simple but excellent tuning possibilities. For instance, a 10 turn potentiometer combined with a 6:1 reduction drive means approximately that a tuning knob, for the example previously given, would cover only 6 kHz per tuning knob revolution. This type of extreme bandspread can be achieved without any great mechanical difficulty whatsoever.

Frequency indication can be achieved by the use of relatively simple meter movements. Basically, once the frequency output is linear with bias voltage change a measurement of the bias voltage via any simple voltage meter is directly proportional

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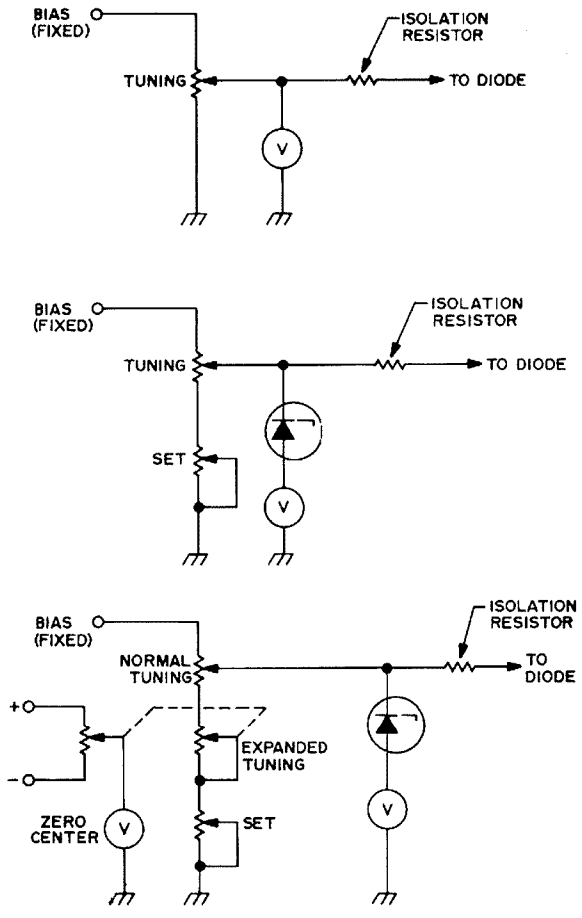


Fig. 7. Various ways of using simple voltmeters as frequency readout devices in conjunction with voltage tuned diodes.

to the oscillator output frequency. The meter can be placed across the bias supply to the diode as shown in Fig. 7(A). The meter scale can then be remarked to indicate frequency, or if the scale is carefully chosen, it might be used directly. For instance, if one is building an oscillator to cover 5.0 to 5.5 MHz and the bias voltage change is 5V to cover this range, the 1V divisions on the meter scale can represent 100 kHz. In most cases, however, things aren't that simply done since the tuning diode is operated over a certain voltage range which doesn't always start at zero. But meters can still be used effectively. For instance, in Fig. 7(B), the main bias supply voltage and the "set" potentiometer are adjusted so the desired range of bias voltage is available at the potentiometer which tunes the diode. Say, a range of 4–9V is used to keep within the linear range of the diode shown in Fig. 5. A 0–5 scale voltmeter can still be used by placing a zener diode of 4V in series with it to form "voltage expander" scale on the meter. One should refer to an article on meter scale changes possible via zener diodes to learn of various other possibilities, all of which are too extensive to cover here.

Perhaps one last example of the versatility possible with various tuning arrangements with diodes is worth while. In tuning an auxiliary oscillator which provides independent receiver tuning for a transceiver, suppose it is desired to have one tuning control which tunes the oscillator in a normal fashion with reasonable bandspread but, in addition, have another tuning control which electronically "magnifies" any small tuning area around that to which the main tuning is set. In other words, the main tuning may cover 30 kHz per knob revolution but the auxiliary tuning takes any frequency to which it is set and expands it either lower or higher in frequency at the rate of 5 kHz per knob revolution. The circuit for doing this is shown in Fig. 7(C). The resistance range and gear reduction drive (if used) on the expand potentiometer is chosen to vary the oscillator frequency any desired small amount. The other potentiometer gauged to the expand potentiometer simply drives any center zero meter so one can return the expand potentiometer to its center position easily before using the main tuning potentiometer again. The scale on the zero center meter can be calibrated in terms of frequency change, plus and minus, if desired, but the indication on the main tuning meter also changes when the expand potentiometer is used so there is never any doubt as to in which direction the oscillator frequency is being changed.

Summary

The ideas presented here are only a few that can be applied to the use of tuning diodes. Other bandspread schemes, automatic band scanners via a triangular voltage to drive the diodes, quick switching between bands for spot checks, and many more are readily possible. The main advantage is that these varied tuning possiblities can be done with simple components at very reasonable costs and an available receiver or transceiver with good calibration used to align the necessary circuits.

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Valparaiso FL

Your October 73 cover is by far the finest I have ever seen. From one who studied art, loves the outdoors and amateur radio, and is a normal male, Mary Jane Trokel is a shapely, pleasant personality, merged with a healthy outdoors and a healthy hobby. In short, the cover is very pleasant and in good taste, and she would make any artist want to paint her in oils.

For summer, how about a cover of her in a bikini with the radio controls for a model boat, or perhaps at the helm of a boat using 2-way radio communication?

Also, how about a cover in color of your pretty and shapely wife? She certainly deserves the honor for putting up with one of us nuts.

I hope the beautiful October color cover sets a precedent for future issues, and please keep the ham-built construction articles coming.

Zoltan T. Bogar
Silver Spring MD

In a recent issue one of your readers stated that Pete Stark K2OAW, did not answer his mail. I must be living right, because he sure answered my request.

I put in a request for the layout of his VHF frequency counter. It required a SASE. By habit, I put Canadian stamps instead of U.S. stamps. Pete put his own stamps on the return envelope and mailed it anyway!

There is the possibility that your reader's letter might have gotten lost in the mail. If hegivesPete another try, I'm sure a reply would be forthcoming.

Tom Webb WA9AFM/VE8
Winnipeg, Man., Canada

This letter is in response and a rebuttal to the letter written by (W1JSS) a Mr. Dineen, as published in 73, the Sept. issue, in which Mr. Dineen complains about the bad cooperation on the part of the author of an article which was published in your magazine, and the author is Mr. Stark (K2OAW).

I, for one, disagree wholeheartedly with W1JSS, as to the response from K2OAW. Mr. Dineen does not evidently know what he is talking about and I say this from experience with K2OAW. I was as dumb as they come when it came to the solid state IC's. I knew you put them together and you expect them to work, everything is fine up to this point, but when I got into trouble, I did not know where to begin to look for my solution and I did not know what the different functions of the different IC's were. At this point I wrote Mr. Stark, explaining my problem, and by return mail he explained quite a few things, and since then I have had the occasion to write Mr. Stark on different problems and he very patiently answered all of my letters very promptly, in fact if the tables were turned around and he was asking me the questions, I would be tempted not to reply, but not Mr Stark, as he has spent quite a bit of time and money to help me and what I know now about IC's, which is quite a bit, I owe to the patience of Mr. Stark. For the record, I have been a ham since 1925, so you see I am not a novice at this game.

J.J. Daris K9VKD
Sterling ILL

WA9TCR's letter in the October issue prompts me to write this letter. I have just rejoined ARRL after a lapse of about 8 years. I dropped out in protest of their speaking in my name without my knowledge in their representations to the FCC. HQ claims to speak for so many thousand amateurs and the only way to dispute it is not to have your name on their list. However recently I decided maybe now there is enough of a movement going that a voting membership could help.

Here is my request. Please introduce a regular column devoted to ARRL news. I am sure you have contacts the rest of us don't have and would be able to publish what QST doesn't. I realize you do this on an irregular basis. This would include a rundown on the directors when they come up for election. In the past I have voted but really they were just names on the ballot and information about them was just hearsay. I and I am sure a lot of others would like to use our vote intelligently. Huntoon won't like it but that shouldn't scare you off, how about helping us?

I think a regular feature or section in your editorial each month would be best so we don't overlook it.

Orbra W. Bliss W9GEK/EL2N
Verona WI

Sounds like a good idea. Maybe we could run a regular ARRL column in the newspages each month to report the behind-the-scenes action at HQ! If anyone has any interesting information that he feels the rest of us should know about, send it in and we will gladly pass it along to the rest of the world.

Sometimes I wonder why you don't reprint some of the extra good "oldies." I appreciated "Mobile Power – The Alternator" and "Solid State Regulator" both in Aug. 1967 issue. With so much mobile activity, keeping your battery "up" should be of prime importance.

Neil W20LU
Tappan NY

It is important! Just think of all the OMs out there with dead batteries . . . just because they didn't cash in on our back issue bonanza offer with a subscription renewal.

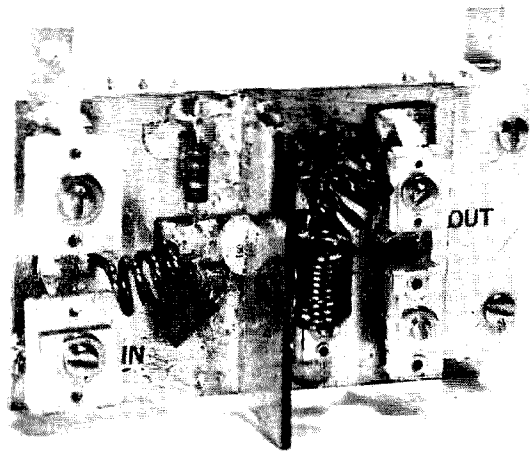
Continued on page 127....

New Products continued . . .

bands from 2 to 2300 MHz (for increased resolution, the reverse power element is ten times more sensitive than the forward power element). Model 4342 Insertion VSWR in 50Ω systems is a low 1.035 to the point of measurement. A choice of QC Quick-Change connectors permits mating with N, BNC, TNC, UHF, C, SC, LC, HN, LT, GR Type 874 and 7/8" EIA lines without the need for performance-degrading adapters. The price is $265, with plug-in elements ranging from $30 to $75. Contact the *Bird Electronic Corporation, 30303 Aurora Road, Cleveland (Solon) OH 44139.*

TWO METER 18 WATT AMPLIFIER

Herman Cone III, WB4DBB
1320-12 Kings Arms Apts.
Chapel Hill NC 27514



This amplifier is designed to be driven with power levels slightly less than is available from many solid state FM transceivers. The RMV transmitter puts out 5 watts, and one can easily get 18 watts of output when using it with this amplifier. Other lower power rigs (3–6 watts) work well, but do not drive it with more than 6 watts.

The amplifier is built on a piece of double sided glass epoxy board and all the foil is left in place except for the thin areas surrounding the seven pads, which are used for solder joints. All leads should be as short as possible. All five trimmers should be soldered directly to the board. The mica compression type work well and are available at most electronics dealers. They are relatively inexpensive, too.

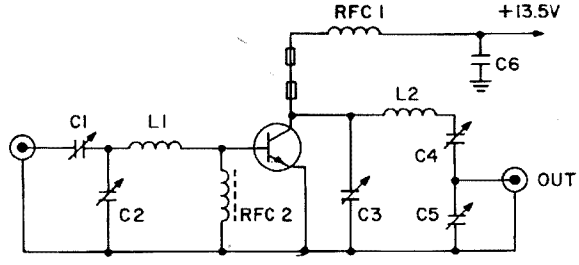


Fig. 1. Circuit of 18 watt amplifier.

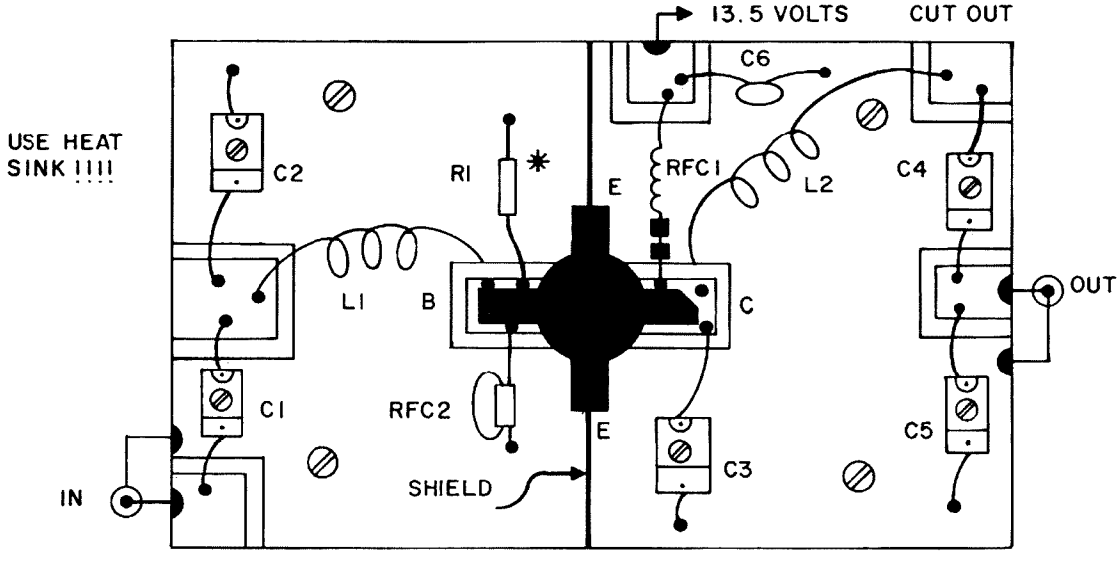
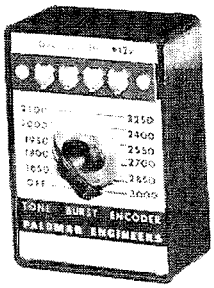


Fig. 2. Full size circuit board showing parts placement. Components mounted on copper side.

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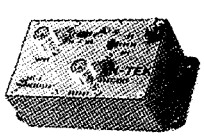
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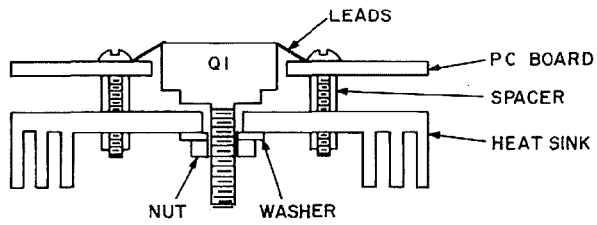


Fig. 3. Side view of heat sink mounting.

Care should be taken when mounting the transistor. First, prepare the board by making the pads and drilling a hole for Q_1. Then mount the board to the heat sink (use a big one) with 4 screws and spacers. Then mount the transistor, using a good heat sink compound. Be sure not to overtighten the transistor's mounting nut. Now, after the board and transistor are secure, solder the 4 leads in place. Both emitter leads go to ground. Then solder the shield (metal or PC board) over the transistor so that it is vertical. Be sure to cut a notch in the shield so that it clears the transistor.

To tune the amplifier up, start with reduced voltage (8–9 volts) and low power (1–2 watts). Tune the trimmers for maximum output. If instability is noticed, you may need to add R_1. When operating properly, the amplifier should provide 5–6 dB of gain with 13.5 volts.

PARTS LIST

Q_1	2N5591 or S3007
C_1, C_2	7-60 pF (ARCO 462)
C_3, C_4	4-40 pF (ARCO 403) 20-250 pF (ARCO 424)
C_5	.02 μF ceramic
C_6	.02 μF ceramic
RFC_1	10 T #18, ¼" I.D., tightly wound, 2 ferrite beads
L_1, L_2	4 T #14, ¼" I.D. x 5/8" long
*R_1	20-100Ω – use if unit is instable → start with 100Ω and reduce when stability is achieved; goes from base to ground.
RFC_2	2 turns in ferroxcube bead

A complete kit of parts minus the heat sink is available from *Circuit Specialists, Box 3047, Scottsale, Arizona 85257,* for $24.95 plus $.50 shipping. They also carry the S3007, $19.50; the circuit board, $4.50; and ferrite beads, $1.00 per dozen. Add $.35 shipping with parts orders.

. . .WB4DBB

F. G. Rayer G3OGR
Longdon Heath
Upton on Severn, Worcestershire
England

SIDEBAND SNIFFER

Years ago when one modulated an 813, pair of TZ40's or whatever, it was nice when testing seemed called for to get a hearing of one's own transmission. This needed nothing more than a diode, pick-up loop of a few turns, and a minimum of other items, Fig. 1. At first I used to put audio into the TX mike circuit from another af source. Later, I used to put the diode output into a tape recorder, and afterwards listen for a minute or two to this reception of the TX signal.

With CW, you can do a similar thing, rf from the TX activating a tone generator.

With the change to SSB on some bands, and separate TX and RX, the latter could satisfy the question about whether the outgoing signal was intelligible, provided rf into the receiver was kept well down, and rf and i-f gains were at minimum.

With the advent of the transceiver, there was alas no handy means at all of making easy checks of what other people were hearing. The SSB Sniffer shown here was built to overcome this.

Method of Working

In the interests of stability, the Sniffer works on one crystal controlled frequency only. The frequency can depend on what old crystals are on hand. Figure 2 is the complete circuit of the Sniffer or spot frequency sideband receiver, which is what it really is. Here, the crystal oscillator is on 3.55 MHz. Its output and a bit of SSB from the transmitter go to the twin diode product detector. The audio output goes to a tape recorder, af amplifier or to headphones.

It is handy to have the Sniffer on a favoured band. If lengthy tests are to be made, it is only fair to put the TX output into an artificial load for their duration. Otherwise eavesdrop on a bit of your own transmission or QSO.

If the transmission sounds satisfactory on the Sniffer frequency, there is every reason

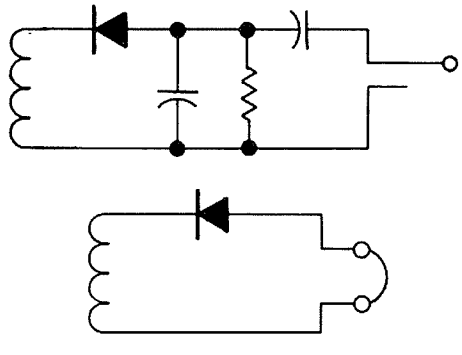


Fig. 1. Simple monitors for checking modulation.

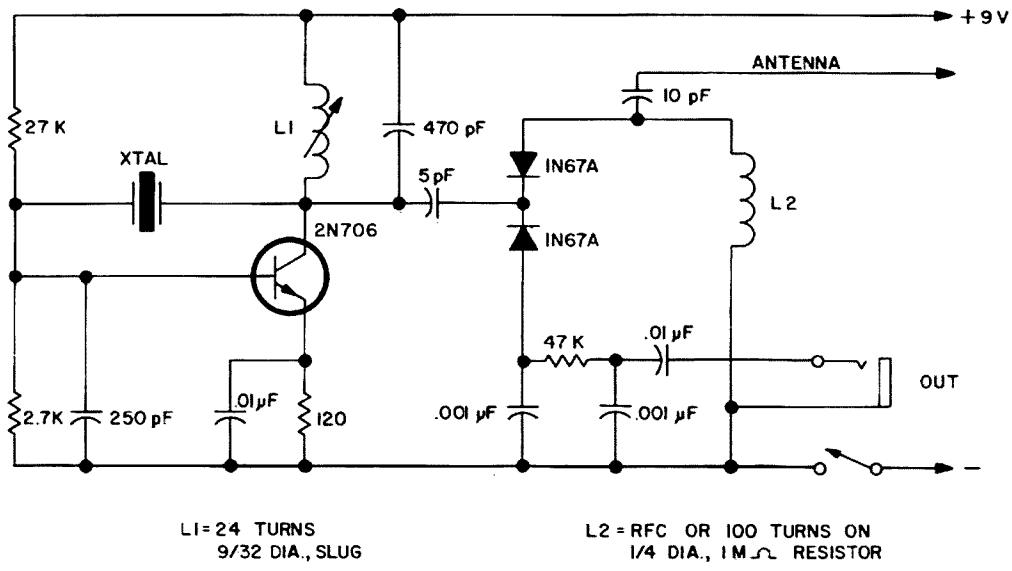


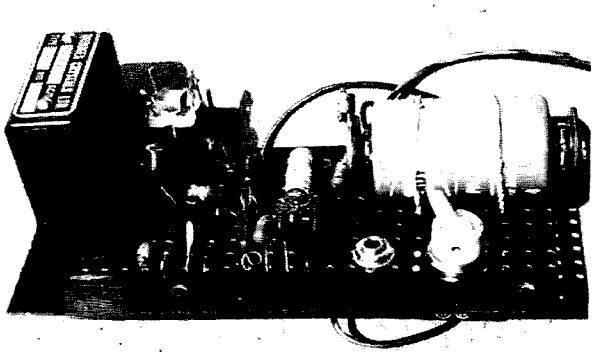
Fig. 2. Circuit of the SSB Sniffer.

for supposing it will also be satisfactory on other frequencies or bands – provided you duplicate conditions of correct PA loading, drive, PA meter peak readings and voice level or mike gain. After all, if you ever used Fig. 1 with a grid modulated PA or other touchy AM circuit, you did not need to make a new check every time you changed frequency.

Building It

The circuit can be wired on any suitable piece of insulated board, the photo is a layout plan for anyone requiring this.

For 80Ω crystals, L1 is 24 turns of 32 enamelled wire, on a 7mm or 9/32" diameter former with adjustable slug, and has a 470 pF parallel capacitor. Some other L/C combination which will tune up would do as well. With a 9V battery, current was about 1 mA with no oscillation, rising to 4 mA with the slug adjusted for maximum oscillation. Need it be said that nothing can work if there is no oscillation.



The 10 pF capacitor is not an isolator, but gives some protection against shorts. Place the "TX" lead near the artificial aerial load, coupler, or aerial circuit somewhere, so that the transceiver S-meter reads about S9 with the gear at receive, and tuned to the Sniffer frequency. (This does not apply with a separate TX, where you naturally provide some rf pickup from the TX to the Sniffer.)

Now switch to transmit, and make the appropriate adjustments to make gain, grid drive, PA tuning, and loading. You may have to adjust the transceiver tuning minutely one way or the other, since you can't tune the Sniffer, and you should in any case move the Sniffer antenna to get a suitable level of rf pickup, as shown by best results. Be sure not to get too much SSB into the Sniffer – this will produce a result sounding like grossly overmodulated AM.

. . .G3OGR

Nat Stinnette W4AYV
Umatilla FL 32784

CRYSTAL FREQUENCY AND ACTIVITY CHECKER

The crystal checker described here evolved from an idea by W2OZH in and old issue of *Hints & Kinks*. It has gone through several stages of refinement, which is usual with homebrew gear. A more sophisticated version is now on the drawing board. Besides checking crystal activity, it measures the difference in frequency of two crystals up to 30 kHz. This difference frequency is read directly on a meter.

Figure 1 shows the circuit diagram. The circuit consists of two identical Pierce oscillators which work in the range of 3–9 MHz using a 6J11 tube. The input capacitance of each oscillator is 32 pF which seems to be the standard for FT-243 crystals. The output of each oscillator is coupled to a 12AT7 mixer stage. The output of the mixer, which is the difference frequency of the two crystal oscillators, is fed to a 6AU6 limiter which presents a square wave signal of constant amplitude to a counter circuit consisting of a meter, two diodes and associated capacitors. A function switch puts the meter in the grid circuit of either oscillator for checking activity. In the center position both oscillators are on, the counter circuit switched in and the difference frequency read on the meter. A range switch selects ranges of 30, 10, 3 and 1 kHz. These were chosen because the meter available was calibrated in these scales. Other ranges should work equally as well, possibly up to 100 kHz.

Construction layout is not particularly critical except that the two oscillators should be symmetrical. As seen in the photo, the counter circuit is built on a sub chassis. This is not necessary – in fact it would facilitate servicing if all components were mounted on the same chassis. The transformer T_1 is used in reverse to provide a better impedance match and more drive.

The capacitors in the counter circuit are critical and the values were determined by "cut and try." If you use different ranges from those shown, the values given will

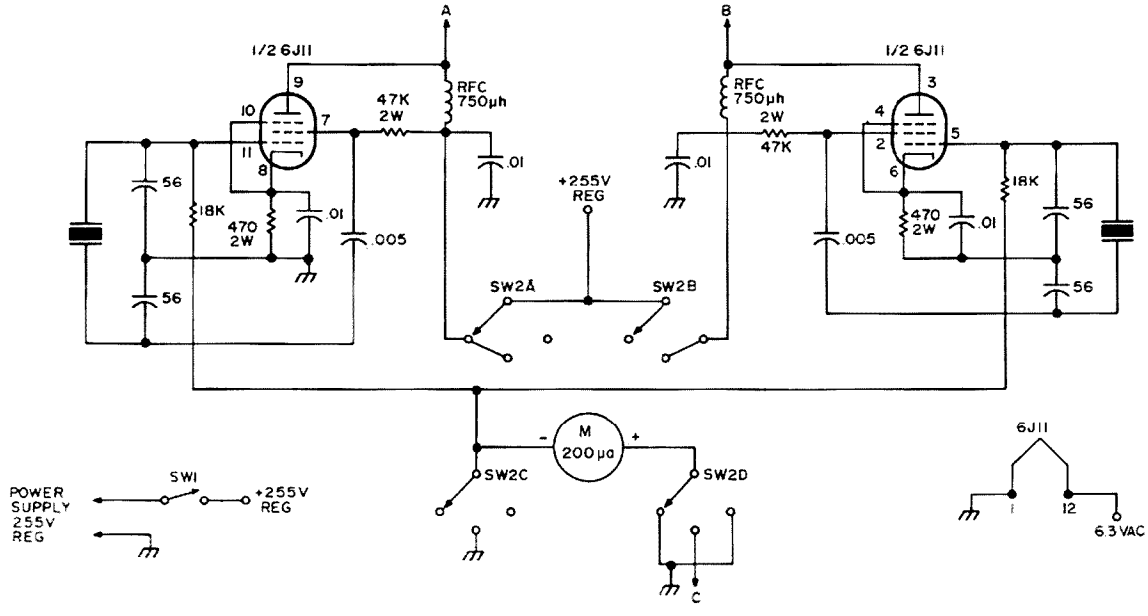


Fig. 1. Circuit diagram of the crystal frequency and activity checker using two identical oscillators.

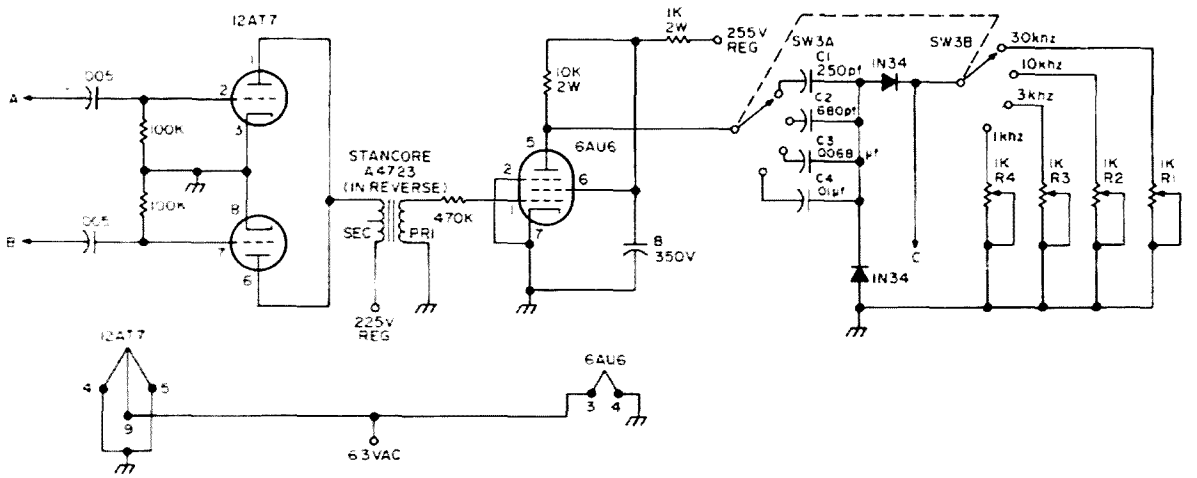


Fig. 2. Circuit of the mixer and limiter stages.

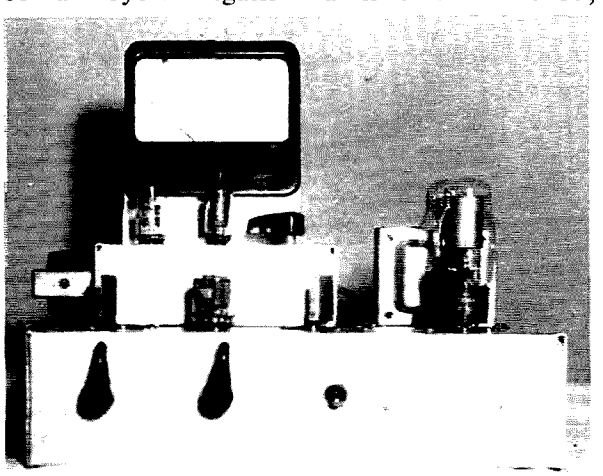
provide a starting point. Use good quality condensers. A little extra investment here will pay off in added accuracy.

After double-checking the wiring, test the oscillators first. Insert a crystal of known good activity in one oscillator. With crystals in the 7–8 MHz range the 200 μA meter should read half scale with the components and voltages shown. Now check the other oscillator. It should give the same reading. If it does not, it is likely that the two halves of the 6J11 are not equal. In this case, adjust the grid and/or cathode resistor in one oscillator to achieve the same readings with the same crystal. The frequency should remain the same with either oscillator.

There are several different ways to calibrate the counter circuit. One simple method is to use four pairs of crystals with exact frequency separation of 30, 10, 3 and 1 kHz. Frequencies outside the ham bands in the 6–8 MHz range will work fine and can be secured at an economical price from surplus dealers. First, use the pair that is exactly 30 kHz apart. With the range switch set for 30 kHz and the function switch in the frequency measuring position, adjust R_1 (the meter shunt) for full scale reading. Now the frequency separation of any two crystals can be read directly on the meter scale, up to 30 kHz. The other ranges can be calibrated in the same way.

Another method of calibration is to use an audio oscillator which is accurate and which will work up to 30 kHz. Feed a signal in at point X which has been disconnected from the transformer. The mixer tube should be removed. Set the audio oscillator at 30 kHz with full output and adjust R_1 to full scale reading. The limiter can now be checked by reducing the audio oscillator output to a point where the meter just begins to drop off. This is the threshold point and the audio oscillator output should always be above this point in order to present a constant amplitude signal to the counter circuit. Now move the audio oscillator to 20 kHz and then to 10 kHz, checking the meter on the 30 kHz scale. If the readings are not linear, adjust C_1 up or down for linearity over the entire scale. The other ranges can be calibrated in the same manner.

Caution: When measuring the frequency of a crystal against a known standard,



The crystal checker. Controls left to right: On-off test, function switch, ac on-off.

NOW

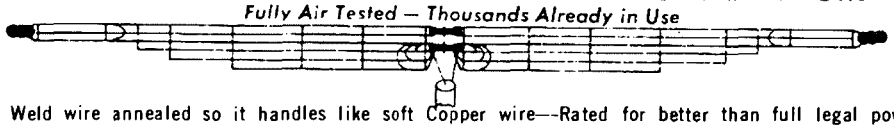
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remember that the output of the mixer is the *difference* frequency so it must be determined if the frequency is above or below the known standard. For example, the known frequency is 7150 kHz and the meter reads 10 kHz. This can be either 7160 kHz or 7140 kIIz.

If, after calibration, the crystal checker does not agree with readings taken on a BC-221 frequency meter, the BC-221 may be suspect. If it is several years old, the spread between check points in the calibration book may be too great. The military instruction book says that check points should be within 1.8 dial divisions on the low band and 1.2 on the high band. This error is not too great when using the fundamental range on the high band but becomes quite significant when multiplied four times. A wide difference in check points is caused by aging of components. One solution is to feed a 100 kHz crystal calibrator (which is zero with WWV) into the BC-221 with its 1000 kHz oscillator on in the "check" position. Many more check points can now be heard. For example, you will hear a check point at 7150 kHz, which would not otherwise be readable. Always choose a check point as close as possible to the frequency being measured. The accuracy of the checker is only as good as the accuracy of calibration so close attention to this is highly recommended.

This instrument has been in daily use here at W4AYV for over a year and the performance has been most gratifying. It would be especially useful for those doing any serious work with crystal SSB filters. For instance, it is possible to more nearly match crystals for zero separation than listening on a BC-221 or receiver. For such jobs only one frequency range would be needed, perhaps the 5 kHz range. This would simplify construction and calibration. In fact, for just matching crystals, no calibration is necessary. It is indispensable when etching crystal blanks for filters. A separation of, say, 1.8 kHz can be read precisely which beats trying to measure such separation on a BC-221.

...W4AYV

George Schreyer WB6TOX
27282 Eastvale Road
Rolling Hills CA 90274

10 AMP VARIABLE POWER SUPPLY

This power supply grew out of the "Versatile Variable Power Supply" described by W6SLP in the June 1968 issue of *73*. That circuit used a capacitive multiplier feeding two germanium type 2N1970 power transistors wired to adjust the output voltage to any desired level. I found several difficulties in his circuit. First there was no way that his capacitive multiplier could supply power to the output transistors when the pulsating dc from the bridge was at an instantaneously low potential. Also that extra filter circuit in series with the high current dc path caused an undesirable extra voltage drop. The 2N1970's in the dropping circuit had a tendency to leak badly under heavy loads. When they leaked too much the output voltage would rise – and the output current would rise – and the temperature would rise – and the leakage would rise – and so on to terminate in a well known result. After two of the 2N1970's rediffused themselves all over the inside of their cases, I decided that this supply just wasn't going to hack more than just a small load.

The supply that I built is a legitimately regulated dc supply that is capable of up to 10 amps at any voltage between 2 and 36 volts, and still remain in one piece. Ripple and noise is less than 10 mV at full load and the output voltage drops off less than ½ volt from no load to full load. It is built of the least expensive and therefore least exotic parts that I could dig up. Many of the components can be found in surplus stores at much less than their catalog prices.

Theory of Operation

This supply uses two silicon power transistors, Q3 and Q4, in a series regulator circuit. They are fed by a full wave bridge and a large filter capacitor. Q3, Q4, Q2, and Q1 form a triple Darlington with a gain of about 400,000 at 10 amps.

Q5 and Q6, along with a few other components, form the error amplifier circuit. These two transistors sense the output voltage and adjust the bias on the regulators so that the output voltage maintains a preset level. Any change in loading on the supply is fed back out-of-phase so that the regulators will compensate for it. Also any input change, including hum, is virtually eliminated by the regulators.

C2 provides a nearly pure dc voltage for the error amplifier. D5 allows C2 to charge from the power path but does not allow it to discharge back. In this way only the small load of the error amplifier is placed on this capacitor. R2 prevents D2 from blowing up when the supply is turned on. R3 provides the collector load for Q5 and will dissipate a little over two watts when the supply is set to a high output voltage.

R4 and R5 balance the current between the two regulator transistors so that one of them will not hog all the current and run too hot. The 10 amp fuse, F2, is there to protect the regulators against a not-too-drastic overload. It probably won't help if the supply is shorted good and proper. One of the regulators will probably succeed in protecting the fuse.

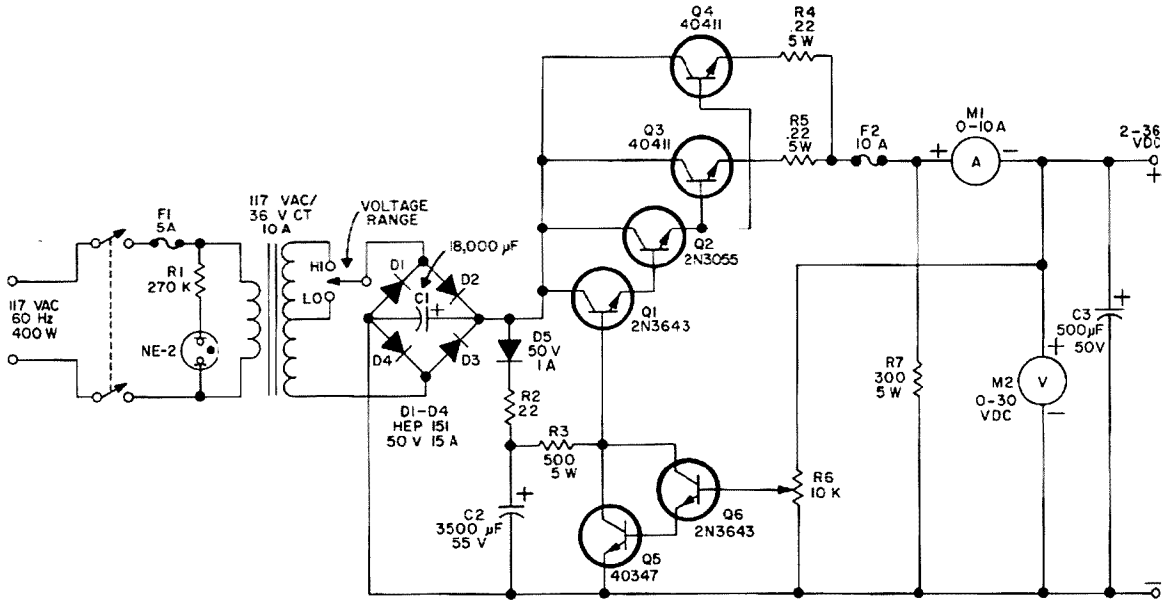


Fig. 1. Circuit of the 2-36V, 0-10A variable power supply.

R7 is a bleeder to keep the output voltage down to about 2 or 3 volts when the voltage control is set to minimum. Any residual output above 2 volts is caused by leakage in the regulators or their drivers.

The voltage control pot is connected to the output connector so that any voltage drop caused by R4, R5, F2, or M1 is compensated for by the regulator.

C3 is to help drop the output impedance of the supply and to provide some transient protection for the supply.

The Design

I have found that a regulated supply can provide about the same dc output voltage as the rms voltage rating of the transformer at full load. The transformer can have the same current rating as the supply is supposed to have and it will behave just fine. With a 35 volt surplus transformer wound with #12 wire, a full-wave bridge, and an 18,000 μF capacitor bank, I could get 47 volts no load and 38 volts minimum at a 10 amp load. This meant that at full load and a 35 volt output, my regulators, Q3 and Q4, could drop no more than 2 volts. I found that the RCA 40411 or the type 2N3772 were two of the few silicon power transistors that would do the job and still not cost too much. These types are rated at 150 watts and 30 amps and cost about $4.25 each. Two in parallel provide all the power dissipation that is required. A type 2N3055 would work for the regulators, but I don't recommend this. They are rated at 115 volts and 15 amps but their $V_{ce(sat)}$ is too high at high currents. $V_{ce(sat)}$ at 5 amps is about 6 volts minimum. This limits the maximum output voltage of the supply to about 30 volts. The 2N3055 has one big redeeming characteristic, however, its cost is half that of the others.

The regulator driver, Q2, should have a low saturation voltage at about 300 mA. A 2N3055 will work here as it behaves better at lower currents. You can use a lower power device than the 2N3055 here as it is never called upon to dissipate more than 15 watts. Just be sure that it has a high collector current rating so that the regulators will not starve for base current.

The regular pre-driver, Q1, can be almost any signal type as long as it has *low leakage.* I_{ceo} should be less than 1 μA, and it would help if the transistor has high gain. A 2N3643, available from Fairchild at about $.50, or a 2N1613, available from just about anybody at $.75, will work well.

The error amplifier, Q6, can be the same as Q1. It should also have low leakage.

I had surplus rectifiers in the bridge, but a funny thing happened when I tried to discharge the filter capacitors with a screwdriver with the power still on. Where I had had four rectifiers, I then had three bolts. One rectifier managed to survive. I replaced the surplus jobs with HEP 151's. These work

very well although they are running right at their voltage rating. They cost $.79 each. A HEP 152 might be a better idea because it is rated at 200 volts, but they cost about $1.25.

When the supply is used at high currents and low voltages, the regulators have to dissipate the most power. At a current of 10 amps and an output of 10 volts or less, the regulators have to dissipate 300 watts or more. This is very rough on the supply but it can handle it. When low output voltages are desired, it is better to use a lower transformer voltage and keep your electric bill down. By hooking the supply to a lower tap on the transformer, such as a center tap, the supply will still work just the same up to 15 volts or so and it will remove 200 watts of dissipation from the regulators. The supply should be turned off and the filter capacitors discharged *before* the voltage range is changed. If you don't do this, you may be buying some more rectifiers. The switch should be capable of handling 10 amps.

Construction of the power supply isn't critical except for a couple of things that are quite important. Any wires that carry the heavy output currents should be at *least* #16 and should be as short as possible. This especially applies to the ground wire. Also Q3 and Q4 should be mounted on *large* heat sinks and the heat sinks should be mounted on the *outside* of the cabinet in a location where they can have excellent ventilation. If possible the fins on the heat sinks should be vertical so the heated air can flow up past the heat sinks with little difficulty. Q3 and Q4 must be mounted with good silicon grease, and, if possible, the heat sinks should be electrically floating and the mica washers eliminated.

The voltage control pot I used has a linear taper, but a reverse audio taper would work better if you can find one. The value is not critical, any value between 5K and 50K will work fine.

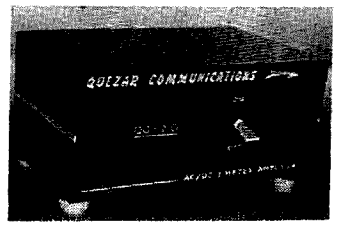
This supply is highly useful to power small projects as well as big ones. It will handle 6 and 12 volt FM two-way radios or 24 or 28 volt surplus gear as well as charge batteries. With a 4Ω limiting resistor it even pulls a nice little arc.

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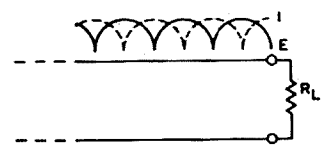
TRANSMISSION LINE SECTIONS

In modern amateur practice the transmission line is usually of the concentric or coaxial type, although it could also be of the parallel conductor type (i.e., shielded or unshielded twinlead and open-wire lead). Most amateurs, if shown a length of coaxial line, could readily suggest the obvious use; namely, interconnecting the antenna and the station equipment. But it would be safe to wager that only a few would be aware that a carefully selected length of transmission line terminated properly can be made to act as a capacitor, an inductor, or even a resonant circuit.

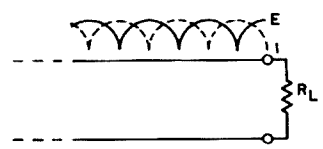
TYPE	DIELECTRIC	VELOCITY FACTOR
COAXIAL	POLYSTYRENE	0.66
COAXIAL	FOAM POLYSTYRENE	0.78–0.80
300 OHM TWIN-LEAD		APPROX. 0.70
75 OHMS TWIN-LEAD		APPROX. 0.80

A transmission line has a characteristic impedance (Z_O) determined chiefly by condutor size and spacing and by the dielectric constant of the insulating material betweer the conductors. If a transmission line is terminated in a load whose impedance is equal to the Z_O of the transmission line, it is said to be flat, or nonresonant. This is the desired condition when using it as a feedline.

However, if the line is terminated in something other than its Z_O, strange things begin to happen. Such mismatch results in reflection of energy from the terminating load and creates standing waves on the line, the interaction of the outgoing and the reflected energy being the cause of the waves. Extreme mismatches occur when the line is terminated in a short circuit or if left open-circuited. Referring to Fig. 1 will give some idea of what occurs. If R_L is much greater than Z_O a voltage maximum results and vice versa. A voltage minimum along the line would mean that the generator would "see" a low impedance if attached at that point. Note that peaks and valleys of either the voltage or current curves are electrically separated by a quarter wavelength.



a) R_L much less than line impedance. Voltage minimum, current maximum at load.



b) R_L much greater than line impedance, voltage maximum, current minimum at load.

Fig. 1. Current and voltage standing waves on a transmission line terminated in a resistive load.

Going on to Fig. 2, consider an open-ended transmission line whose length is an electrical quarter wave. The terminated end is "shorted" by a load whose impedance is infinite and therefore a voltage maximum will exist. A voltage minimum will exist a

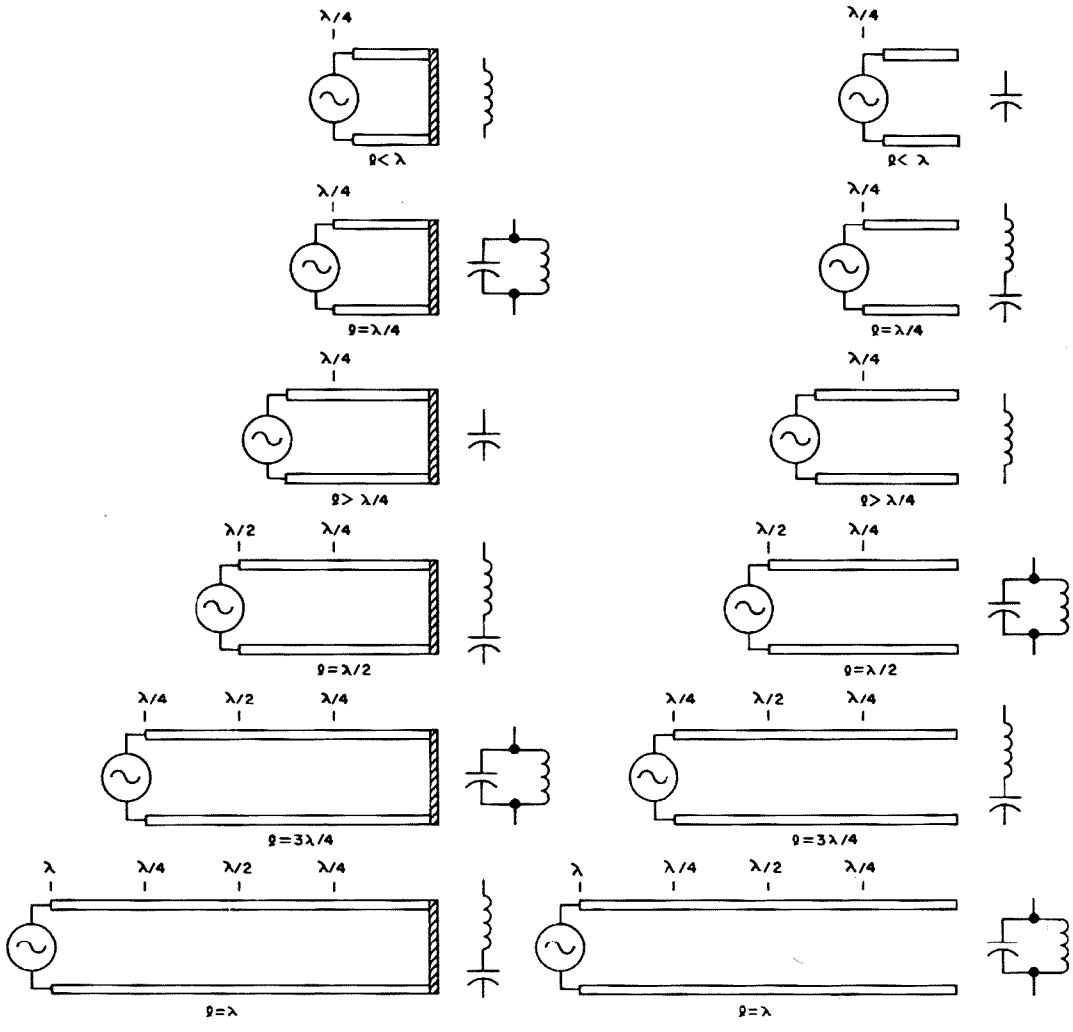


Fig. 2. Impedances experienced by an rf generator for various lengths of transmission line.

quarter wave to the left — which incidentally is where the generator is attached. Remembering that a series-tuned circuit acts like a short circuit at its resonant frequency and that the generator is seeing a very low impedance beause a voltage minimum exists there, it seems logical that the line could be acting as a series-resonant circuit, as indeed it is. Quarter wave and half wave sections of transmission line have many practical uses, as further study of Fig. 2 will indicate.

These sections will be frequency sensitive and will have high Q. When designing transmission line sections, the physical length of

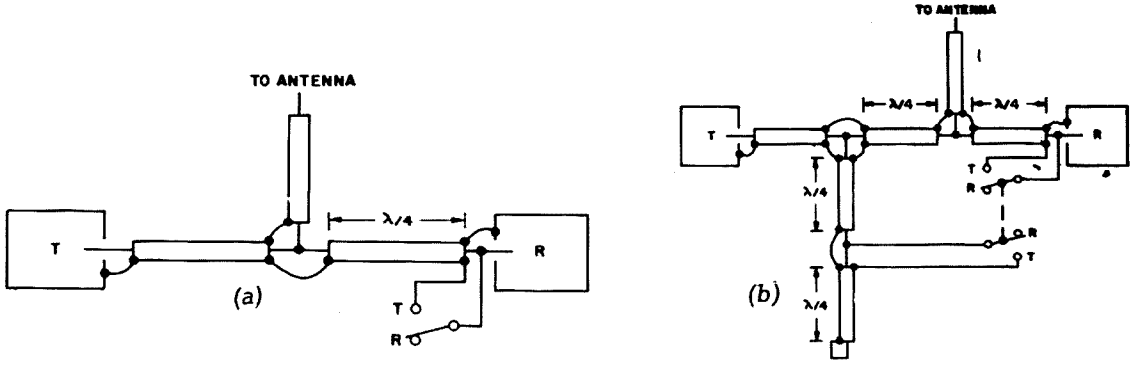


Fig. 3. T/R siwtches for single band operation: a) without transmitter isolation and b) with transmitter isolation.

the section will be found to be less than the free-space wavelength, and is calculated by multiplying the velocity factor times the free-space wavelength. Jim Fisk's Coaxial Transmission Line Handbook[1] contains several tables pertaining to the physical length of coaxial line sections. Some of the standard and not-so-standard tricks with transmission line are touched on in the remainder of this article.

Coax Tr Switch

The switches shown in Fig. 3 utilize quarter wave and half wave sections in the shorted condition to provide receiver isolation during transmit. Dual-band operation is possible on certain harmonically related bands such as the 40 and 15 meter bands if frequency excursions are not too far from the design center frequencies. Such operation is possible because odd multiples of

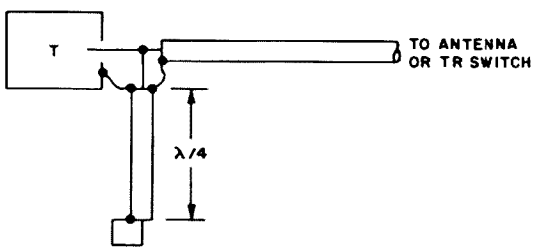


Fig. 4. Harmonic interference trap for transmitter use.

quarter wave sections repeat their characteristics (see Fig. 2). A mechanical switch of some type must be used to short the sections; however, the voltage and current ratings are not too stringent.

I have constructed 50 MHz versions of both Tr switches and found them to work quite well, but no absolute measurements of isolation were made. An attempt to use back-to-back diodes to give automatic shorting of the quarter wave sections on transmit did not give the required isolation – this was to be expected.

Transmitter Harmonic Trap

This type of trap is very effective over a limited frequency range and may be very helpful in eliminating channel 2 TV interference caused by 10m transmitters. Receiver harmonic traps may be constructed from

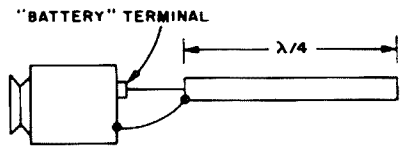


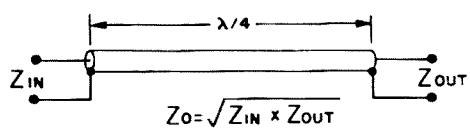
Fig. 5. Alternator filter using open quarter wave coax section.

open-ended quarter wave sections and are placed in parallel with the antenna terminals of the receiver[2]. If the transmitter is at 28 MHz, even harmonics (54 MHz, 112 MHz, etc.) are attenuated.

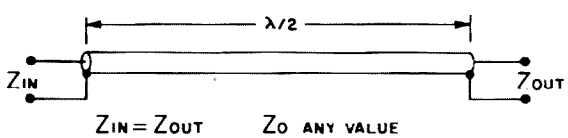
Alternator or Generator Hash Filter

More than one trap may be paralleled to get two- or three-band operation.

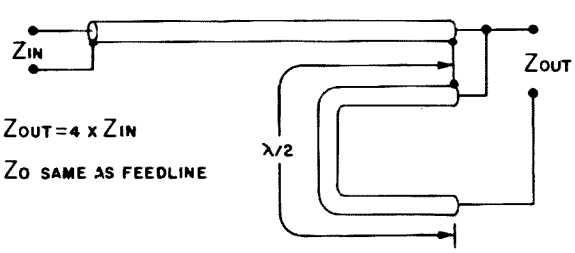
Referring to Fig. 6a, the quarter wave transformer can operate both as a stepup and stepdown rf transformer. For example, if Z_{in} is less than Z_O, then Z_{out} will be greater than Z_O. Of course the reverse also holds true. A common application of this



a) Quarter wave matching transformer for balanced or unbalanced transmission lines (unbalanced shown).



b) Half wave matching transformer (1:1 ratio). Applicable to balanced or unbalanced line.



c) Trombone matching transformer (4:1 ratio). Unbalanced to balanced (in direction of impedance stepup) shown.

Fig. 6. Transmission line sections as matching devices.

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device is to match the 70Ω impedance of a transmitter to a quarter wave mobile whip whose impedance is about 20Ω. Using the formula given, the Z_0 of the line would be about 50Ω, so a section of 52Ω coax works fine. Although it would not be feasible to delve into the theory of operation of this transformer, its operation is related to what you have seen in Fig. 2 for the open and shorted quarter wave line sections.

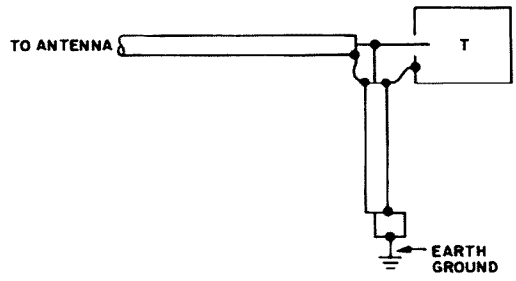


Fig. 7. Lightning protector and static drain.

Lightning Protector and Static Drain

This device can be placed at the transmitter or even at the antenna if a good ground is available. It provides a dc ground but does not ground rf at the frequency it is cut for. Naturally it is inherently a narrowband device, but it does have application with single-band antennas.

In summary, then, these sections are very selective and can provide accurately tuned resonant circuits with only a tape measure and a pair of sidecutters. They make excellent single-band rf transformers. They can be used to construct low-loss rf switches Although nothing was mentioned on the subject of matching stubs, it is possible to use lengths of transmission line to supply capacitive or inductive reactance for the purpose of matching an antenna to a feedline. This review of transmission line sections could at best only hope to skim the surface, since the theory behind these devices would fill a book. It is hoped the reader will pursue this subject further and in greater depth.

. . .VE4RE

References

1. Fisk, *Coaxial Transmission Line Handbook*, 73, July 1966.
2. Rand, *Television Interference Handbook*, The Nelson Publishing Company.

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Philadelphia PA 19120

RADIO ASTRONOMY for RADIO AMATEURS

The thought of optical astronomy conjures images not only of Mount Wilson and Palomar but also of the many thousands of amateur observers throughout the country. On the other hand, radio astronomy brings to mind visions solely of huge installations such as Arecibo and Jodrell Bank; this is in large part due to the availability of small visual instruments, which makes amateur participation possible, and popular. Such optical observers send in hundreds of reports each month to national societies such as the American Association of Variable Star Observers, and their data prove invaluable to astronomical research.

Predictably, radio astronomy currently has no similar "sky patrol." However, it is possible for hams to initiate such a watch on their own with a reasonable initial outlay using essentially what equipment they presently possess. I intend to show in this brief article what kind of set-up is necessary and what data can be obtained from radio astronomical observation.

One of the primary factors influencing the quality of HF and VHF radio transmissions is the emission of the sun in the region of the electromagnetic spectrum from the ultra-violet through the x-ray domain. Some correlation exists between visually observable sunspots on the one hand, electronically detectable solar radiation in the HF and VHF range, and short-term behavior of the ionosphere on the other. Analysis of either or both of these phenomena can have substantial predictive value for skip conditions. The ham is in an ideal position to gather, analyze, and make use of such data. This is still a wide open field where original research with simple equipment can potentially be of significant scientific value.

A brief word on the history of radio astronomy may suffice. Forty years ago, January of 1923, Karl G. Jansky, a Bell Telephone engineer, detected "a steady hiss type of static of unknown origin." He had discovered the radio emission from the center of our galaxy at a frequency of 20.5 MHz. Five years later Grote Reber, working with a homemade parabolic dish antenna in his backyard started exploring the sky in the VHF region. In 1944 he published the first maps of the radio sky and in the same year detected solar radiation at 10 MHz. G. C. Southworth and J. S. Hey subsequently found solar thermal emission at centimeter and meter wavelengths, respectively. The developments in radio astronomy since the war (the prediction and detection of the interstellar hydrogen line at 1420 MHz, to name one) have been too numerous to recount here; the interested reader is referred to the works listed in the bibliography.

How difficult is it to get started in radio astronomy? Not at all, really. This author has successfully supervised a group of high school students using little more than unsophisticated FM receivers and TV antennas to observe both solar and extra-solar radiation. The advanced amateur radio astrono-

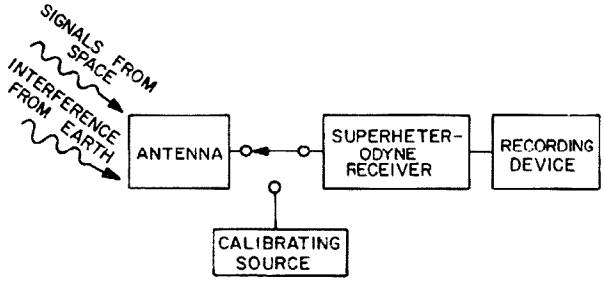


Fig. 1. Block diagram of a radio telescope.



Fig. 2. The 22.2 MHz receiver and Esterline Angus recorder at the Kalbfleisch Field Research Station.

mer may eventually wish to expand his observations to extra-galactic sources which provide a greater challenge due to the generally weaker signals involved. But the sun makes an ideal first target because of its relative strength and discernible effect on radio communication.

A radio telescope consists basically of the items shown in Fig. 1. Initially, the calibrated source can be omitted since measurements will be taken relative to an arbitrary baseline. A desirable receiver will have a very low noise figure and extremely high gain stability (for every gain variation is seen as a change in the recorded noise level). Typically, regulation to 1 part in 40,000 for high voltage and 1 in 3,000 for filament voltage are employed. The recording device for our purposes could be no more than a glorified S meter, but preferably a strip line recorder.

In 1968 I first experimented with the feasibility of a small scale radio observatory at the Kalbfleisch Field Research Station (Huntington NY) of the American Museum of Natural History. Our "shack" consisted of a single channel receiver operating at around 22.2 MHz, an Esterline Angus model AW recorder, and an eight element Yagi (see Figs. 2 and 3). We naturally directed our attention to the sun, being the strongest source of extraterrestrial radio waves with the qualified exception of Jupiter, but that's another story entirely. Using the armstrong method we were able to point the beam at the sun throughout the greater part of the day. (By the way, it gave excellent results on 15 meters.) After a while we were able to identify the various types of solar bursts we had recorded, and recognize their characteristic sound when we heard them again. A detailed description of these emissions can be found in Steinberg and Lequeux. (See bibliography.)

Although virtually any type of antenna may be used initially, the ordinary three element beam (or, of course, larger) is preferred because of its directivity and subsequent gain. The feed line should be adequately shielded and unbroken from antenna to receiver. Any possible sources of attenuation, such as T-R relays and lightning arrestors, should be removed from the line (unless one is monitoring a local lightning storm, in which case an arrestor is a necessity!).

The receiver should be ideally a single conversion superheterodyne with a high S+N/N ratio. A rough way of ascertaining the noisiness of your receiver is first to listen on a clear frequency at midday, using the widest selectivity available, with the antenna first connected, and then with a 50Ω resistor across the receiver input terminals. The drop in noise level should be significant. Repeating the test at three in the morning should yield an almost imperceptible change. This is

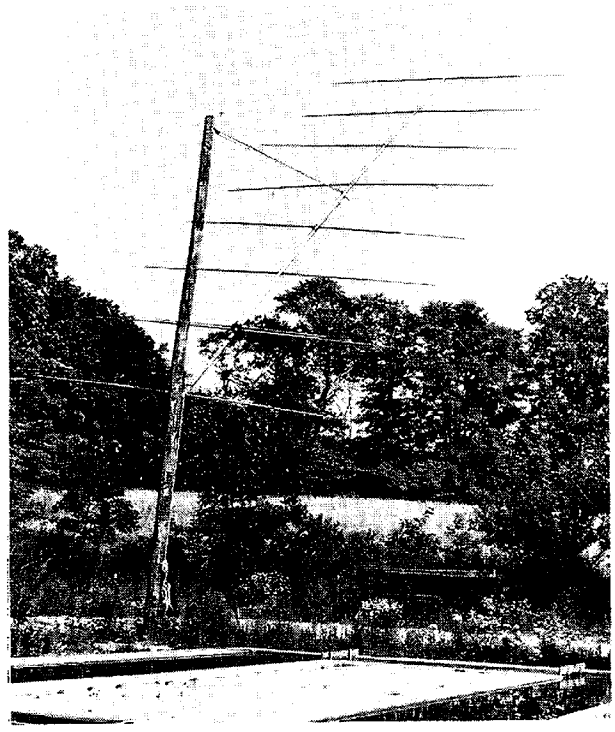


Fig. 3. View of the eight element beam used in the Kalbfleisch system (photographs courtesy the American Museum of Natural History).

a good sign that the system is both quiet and sensitive enough to make detection of solar emission possible.

Up to this point I have not mentioned what frequencies should be used for observations. The three major considerations here are transparency of the ionosphere to incoming signals of that frequency, freedom from terrestrial interference (both communications and noise), and performance of your system (receiver plus antenna) at that frequency. As a rule the 15 meter band is a good place to start. The Kalbfleisch station has for several years monitored extraterrestrial sources at 21 MHz using only a commercial three element monobander for an antenna.

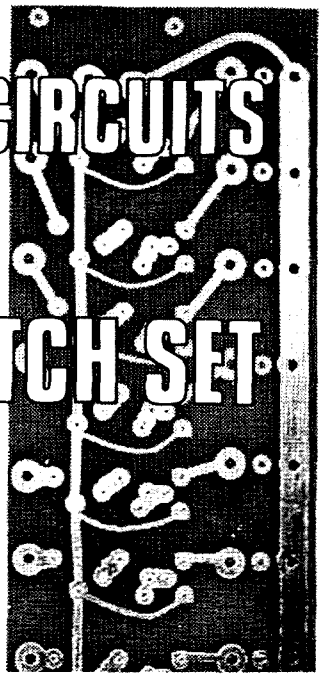
Choose what appears to be a clear frequency either below or above the ham band. International fixed stations above and aeronautical stations below will make frequency selection a difficult matter. After you have found an open spot, stay tuned to it for several days using the broadest selectivity to ascertain its freedom from potentially interfering stations. Listen carefully and after a while you should begin to recognize noise that sounds not like ordinary QRN. If you are fortunate enough to have once heard an audio recording of a solar flare, you might identify what you are receiving as such. Remember to use broad selectivity – the purpose of this is to allow as much as possible of the signal (which is essentially broad banded) to go through, since power output will be directly proportional to bandwidth. The Kalbfleisch unit uses in its i-f amplifier a crystal filter with a width of 13 kHz.

Now that you are reasonably certain the sun is coming through well, you can consider the matter of recording the output. There are several choices available as to from what stage the signal should be taken. At Kalbfleisch we rectified the audio output of the receiver, and having imparted a characteristic time constant to it (R x C), fed it into the 0–1 mA graphic recorder (Fig. 4). The purpose of the back biasing arrangement is to allow the recorder pen to be positioned so that the full scale of the instrument can be used. The 47,000Ω resistor simply isolates the dc power source from the recorder.

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Clearly, the higher the value of R, the lower the current the recorder will see. We were hard put to find individual paper capacitors to provide the necessary time constant of about five seconds. Electrolytics were avoided since experience has shown that their capacitance varies too much with time and temperature to be useful in serious work, though they are perfectly satisfactory for initial observations.

An alternative to rectifying the audio output is taking the filtered detector voltage from the receiver, which will be in the order of 1/2 volt, pass it through an RC circuit similar to that in Fig. 4 and then feed it directly to a recorder with the requisite sensitivity. During period of observation the receiver avc should be turned off or grounded at the appropriate place, since the R-C combination provides the time constant regulation necessary; the anl, noise blanker and such should also be off.

A graphic recorder is the one piece of equipment needed to complete your observatory. Unfortunately for the prospective radio observer the prices of new units tend to be rather high. A survey of Philadelphia and Washington, D.C. surplus shops reveal a preponderance of recorders designed for 220 volts ac at 50 Hz, which can be bought for less than $80. The effect of running such an instrument on a 60 rather than 50 Hz line is that the chart speed will be slightly higher than normal, just enough as to make time readouts on standard paper difficult. If you are inclined to experiment a little with clockwork, it is possible to build into an ordinary wall clock a device which will send out pulses every so often, say at hour or half hour intervals. This way the time of a particular event can be readily determined. As an alternative to purchasing a recorder, the physics department of a local university can be checked out as a source of a loan of one.

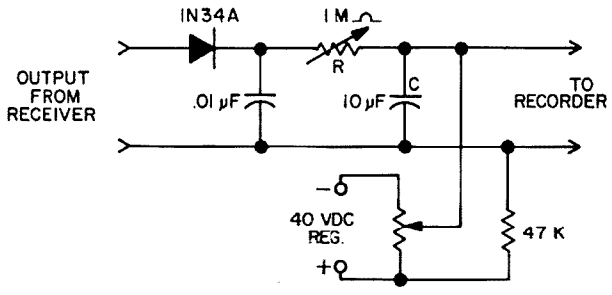


Fig. 4. Detector and back biasing circuit used between the receiver and recroder. The variable resistor R and the capacitor C determine the time constant.

Just to become acquainted with the noise strength profile at the frequency you have chosen, let the recorder run at five to six inches an hour for several days. Because of ionospheric absorption and divergence (see Hanbury Brown and Lovell, p. 16), signal strengths will be greater towards midday. Studying the profile of bursts requires a speed of twelve to twenty inches per hour, but this must not be done indiscriminately, lest you find your paper consumption getting out of hand.

The information you should seek as a result of your observations is what correlation exists between type and intensity of solar outburst and propagation on the amateur bands. Data such as what frequencies, areas and paths are affected are of great interest. I would be pleased to hear personally of the problems and progress the amateur radio astronomer encounters.

I have concentrated here only on the sun, being the most readily observable radio source. If you are so inclined you can find a list of celestial radio emitters in the several books on radio astronomy listed in the bibliography. It will hopefully not be long before optical astronomy associations have their counterparts in radio astronomy. Hams could potentially provide a vast amount of valuable data to the scientific community, and themselves gain an understanding of the still obscure workings of the universe.

. . .WA3CXG

BIBLIOGRAPHY

Books:

Hanbury Brown and Lovell, *The Exploration of Space by Radio*, New York, 1958.

Kraus, *Radio Astronomy*, New York, 1966.

Landmark (ed.), *Meteorological and Astronomical Influences on Radio Wave Propagation*, New York, 1963.

Motz and Duveen, *Essentials of Astronomy*, New York, 1963.

Articles:

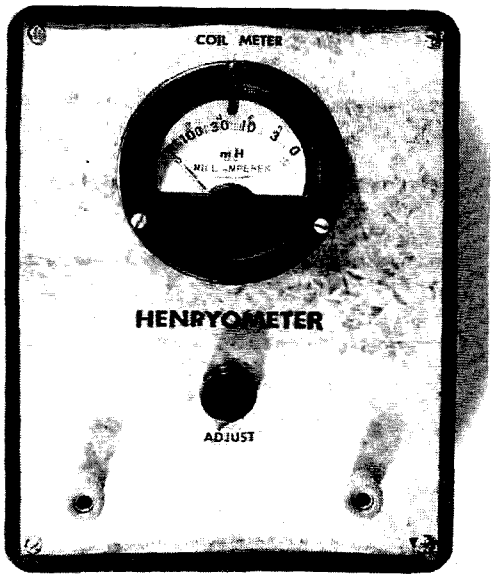
Hyder, "Receiver Sensitivity," *QST* September, 1969.

Ibid, "Atmospheric Noise and Receiver Sensitivity," *QST* November, 1969.

Lund, "Using Sun Noise," *QST* April, 1968.

Jim Clack WA8MLP
14525 Longacre
Detroit MI 48227

A DIRECT READING INDUCTANCE METER... THE "HENRYOMETER"



I know for a fact that many of my friends, as well as myself, have boxes of chokes and coils which are of no use without known values. Most of these inductors, it will be found, are still good and may have applications in projects. Even though the chokes may be aged and dusty, underneath may be a coil that could save you a bit of money on that receiver or linear you are about to build. All you need to save yourself this time and money is a "Henryometer." Unlike bridges, which are slow, and many times inaccurate, or the capacitance method of resonating with a grid-dip meter, the Henryometer reads directly, like an ohmmeter. All it should cost you is a few parts from the junkbox and a little time.

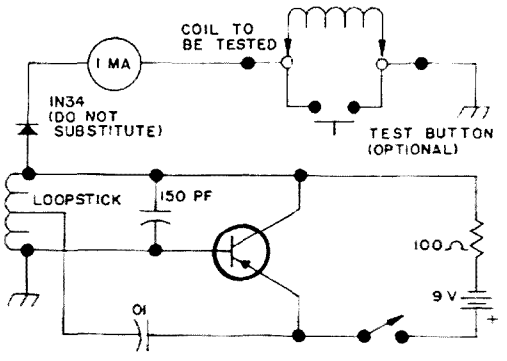


Fig. 1. Circuit of the direct reading inductance meter.

The Henryometer is based on the formula for inductive reactance. This states that the two variables which control reactance are frequency and inductance. Since the Henryometer supplies the frequency, inductance will control reactance. Thus, this is a reactance, or ac ohmmeter. It operates in the same way as a dc ohmmeter except that an oscillator replaces the battery, for an ac current; and a diode on the meter changes it back to dc to register on the direct current milliammeter.

You will find this meter very easy to build and simple to operate. Most any PNP transistor will work in it, but the diode *must* be a 1N34. The case can be made very small, for all that need be contained is a battery, meter, potentiometer, and small circuit board. To test a coil, connect it across the terminals, push the test button (or connect the leads as with an ohmmeter), adjust the control for zero, or one mA, let up on the test button, and read the value indicated. You may calibrate it with known values. It should read accurately from .25 to 10 millihenries. You might wish to add ranges by adding a selector for meter shunts. One important precaution is to use leads as short as possible to keep added inductance as low as possible.

. . .WA8MLP

TRANSVERTER FOR 20 METERS

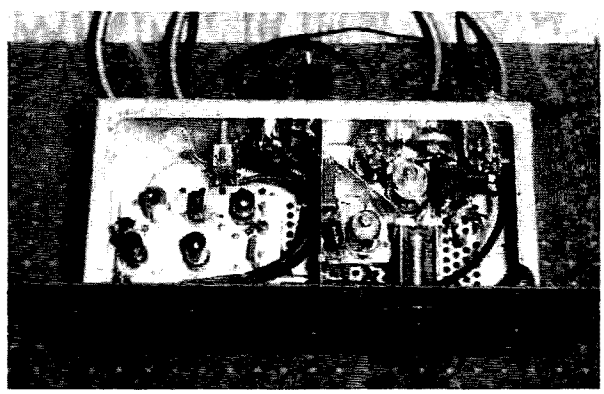
Paul L. Schmidt W9IDP
214 North Washington
Bloomfield IN 47424

Expand the coverage of your single or dual band transceiver with a unit that features convenient high-level mixing.

This is primarily for those having single-band or two-band transceivers having 75 or 80 meter capabilities but with no provision for 20 meter operation. This describes an outboard 20m transverter which is hooked into the transceiver antenna line like a linear amplifier with its receiving and transmitting functions controlled by the transceiver working on 75m.

The transverter uses the same crystal for both receiving and transmitting conversion. This way the transceiver you are using "thinks" it's on 75 while it is actually on 20m. Aside from the added 20m coverage, no modification of your present transceiver is made; thus, the resale price is unaffected.

Whenever I am exposed to a "how to" article, there is always something not just



exactly right about the other author's design. Therefore, the reader is here encouraged to receive my ideas in the same light, to make his own improvements or modifications to what is described.

Figure 1 gives the functions of the transverter stages. I use a 6.025 MHz

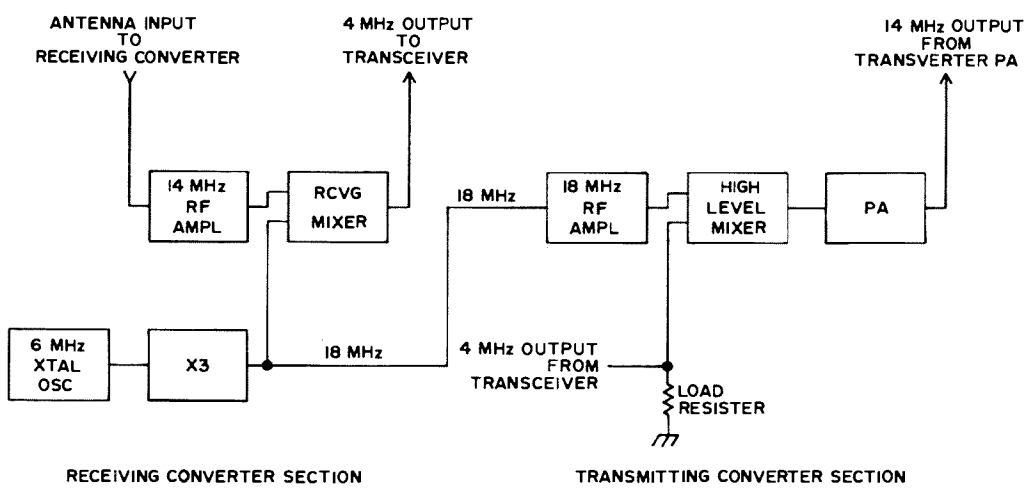


Fig. 1. Functions of transverter stages.

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ACTIVE EDITORS

Only one ham magazine of the four has editors that are active and on the air – and have been for years. 73 has its own repeater going – the only ham magazine staff that has done this. 73 has its own mountain top laboratory for VHF – the only ham magazine with one. 73 is active on slow scan television – the only magazine to do this. 73 goes on DXpeditions – the only ham magazine to do this. 73 runs DX tours – the only ham mag to do this. And so it goes.

And what difference does all this make? Perhaps you've noticed that 73 is more involved with the hobby – 73 not only reports the most interesting news, sometimes it helps to make the news. It helps 73 to be more fun to read, to attract better authors for articles, to bring you more valuable information on the newest of ham products.

Which ham magazine was the first to report on the first commercially made two meter synthesizer? 73 of course. And which got the first new units made by Genave? And which got the first Clegg units? The first International Signal units? The first Drake FM units? The first Tempo units? And so on – being active and on the air helps make 73 more interesting and valuable, doesn't it?

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If you prefer not to shred your copy of 73 there is no real reason why you should not put the subscription information on a separate piece of paper, on the margin of a hundred dollar bill, or whatever turns you on.

Regular subscriptions ordinarily start with the next published issue of 73 – the November issue, in this case. Gift subscriptions marked for Christmas will start with the Giant January issue since that is the one that should arrive right around Christmastime. If you want otherwise just indicate same on the order.

The regular subscription rate for 73 is $6 for one year $11 for two years, $15 for three years in North America and $1 extra per year for foreign subscriptions. This special book premium offer is valid world wide at $6 for one year until December 31, 1972.

The recent serious rise in postal rates will be forcing 73 to increase the subscription rate soon – don't say you weren't warned.

Did you enjoy the article in August on the DXpedition to Navassa? This is one of the reasons that 73 is different – it is involved. The editors get out there and operate, go on DXpeditions, organize them even – organize ham tours – set up repeaters – work in the contests – work lots of DX – are actually on slow scan – on RTTY – it makes the magazine come alive. When the editors write about something you know that they have the background to bring you the inside scoop. If you are the type of person who fights progress – opposes change, you are going to find 73 getting your back up, for 73 is in there first with the new things.

Amateur Radio
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When you read 73

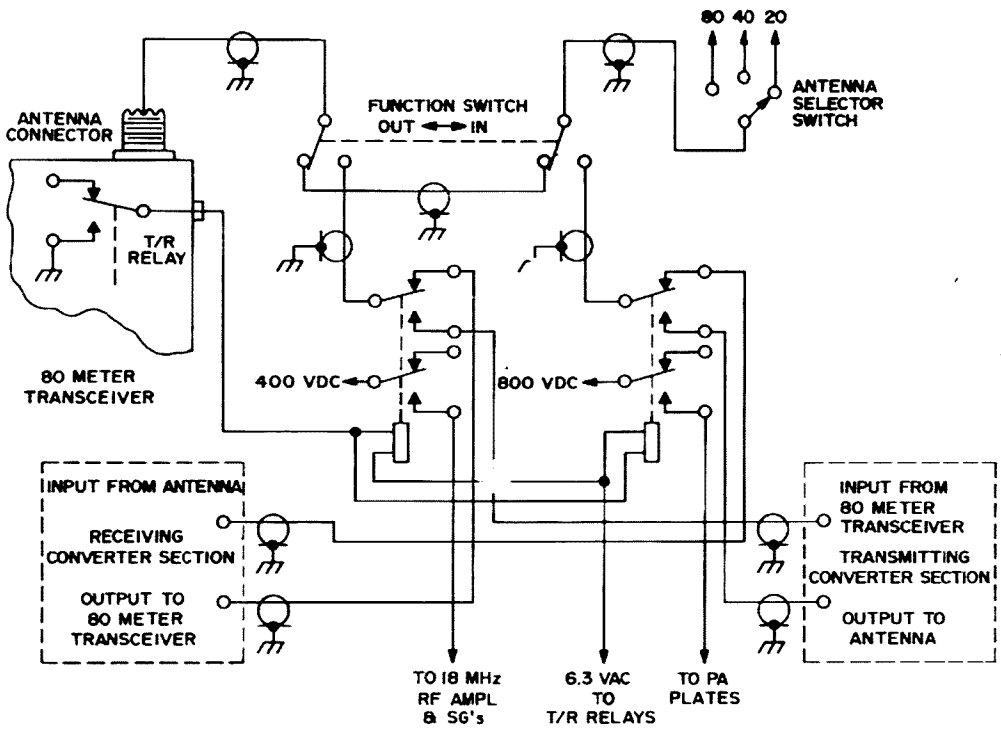


Fig. 2. Transverter control circuitry.

crystal oscillator and triple to 18.075 MHz. Then the amplified incoming 14 MHz signal heterodynes in the mixer with this to produce the 4 MHz output for the transceiver's receiver. The receiving converter and crystal oscillator–tripler remain on during the transmit mode, but during transmit, an additional 18 MHz rf amplifier turns on to provide more 18 MHz power for a high-level transmitting mixer.

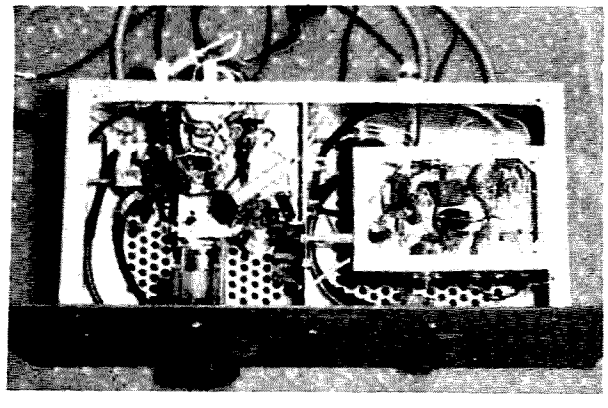
And in the transmit mode, your transceiver's 4 MHz output goes into a 50Ω load in parallel with the input of the high-level mixer, the output of which drives the 14 MHz power amplifier.

My crystal oscillator frequency of 6.025 MHz was chosen because the crystal happened to be on hand. Its third harmonic, 18.075 MHz, mixes with 4.000 MHz to give 14.075 MHz for CW operation, and 3.800 MHz lower sideband (the low end of the dial of my WRL Duo-Bander 84) produces 14.275 MHz upper sideband. Note that the required sideband inversion is accomplished in the conversion process

A happier choice of crystal frequency might have been 6.067 MHz, whose third harmonic, 18.200, would give full phone band coverage and a little bit more, going from 14.200 to 14.400 MHz.

Because your transceiver dial isn't calibrated for the 20m band, and since the aim of this exercise is to keep your transceiver unmodified, it becomes necessary to make a conversion chart in order to know your operating frequency. A suggested design is shown in Fig. 6.

To have the transverter in the transceiver antenna circuit at all times, like a linear amplifier, it must be switched from "out" (straight through) to "in" (transverting to 20 meters) by means of a substantial double-pole-double-throw wafer switch. Two DPDT relays perform the transmit-receive operation from your trans-



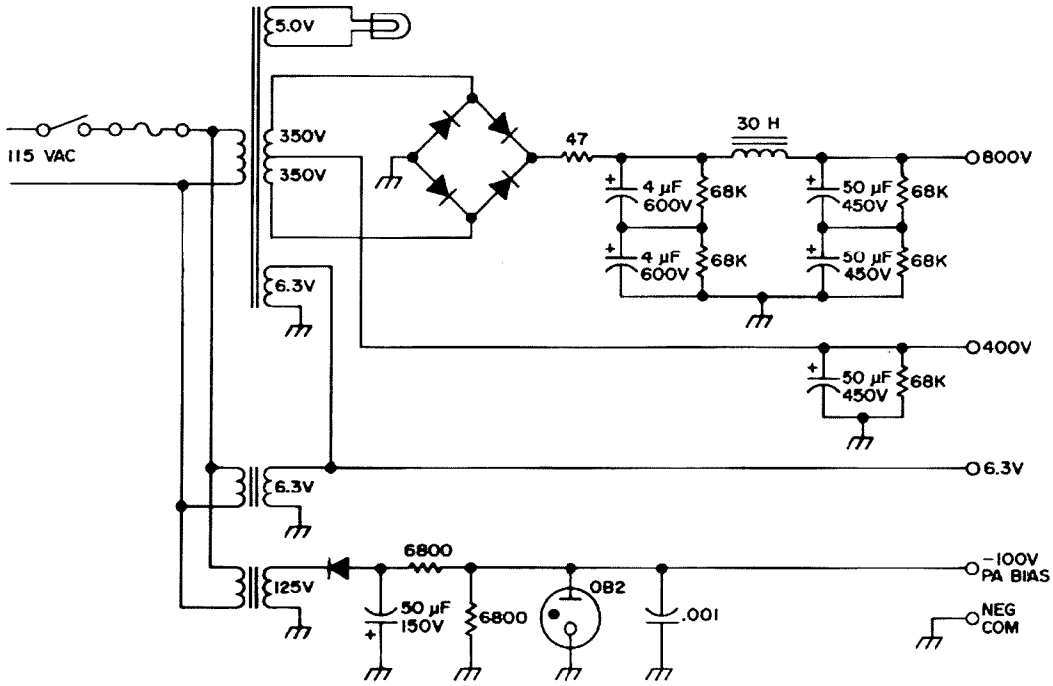


Fig. 3. Transverter power supply.

ceiver's TR relay. Control circuitry for all this is shown in Fig. 2.

Now that the functions have been roughed in, the construction steps should follow in some logical order. Plan your layout for ease of maintenance and repair if possible. The one I built requires removal and replacement of nine screws just to change a pilot bulb.

You might like to complete the receiving converter and power supply first. Then you can listen to 20m while completing the transverter. Don't forget to unplug the microphone from your transceiver during the construction phase while listening to 20m; otherwise, you might forget and transmit through the receiving converter (not recommended). A grid dipper is a must for pruning and tuning. If you don't own one, better borrow one.

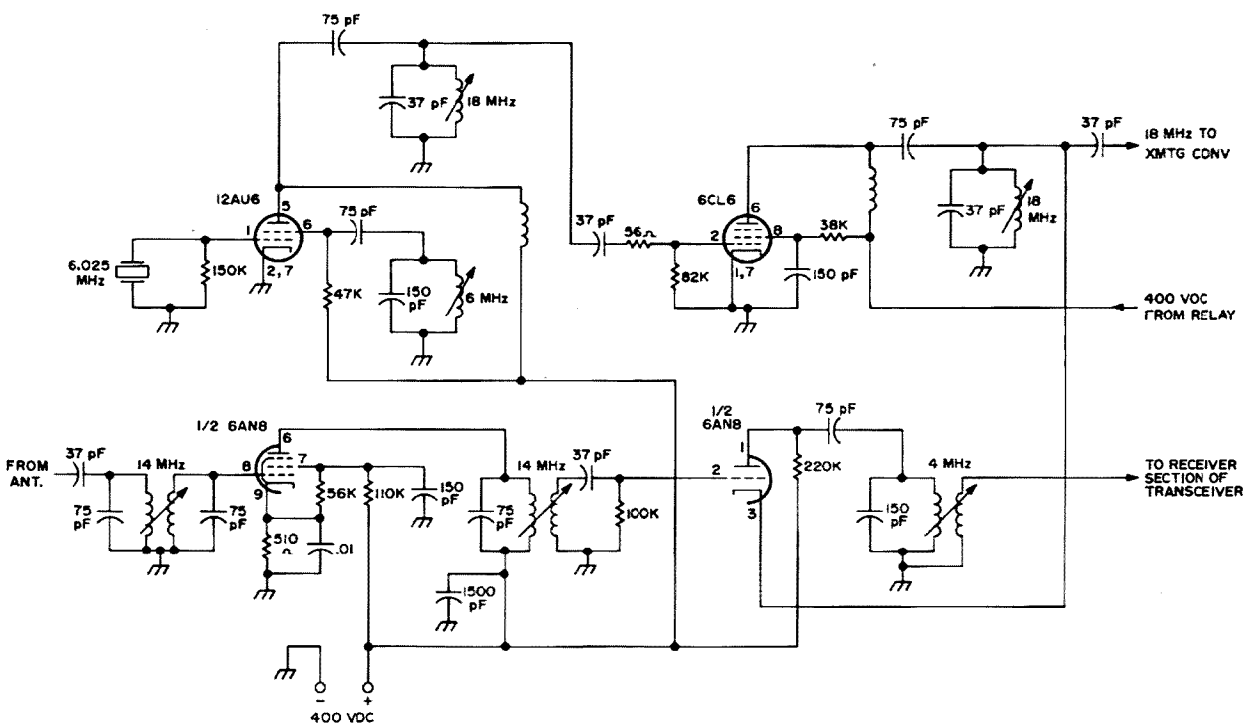


Fig. 4. Receiving converter.

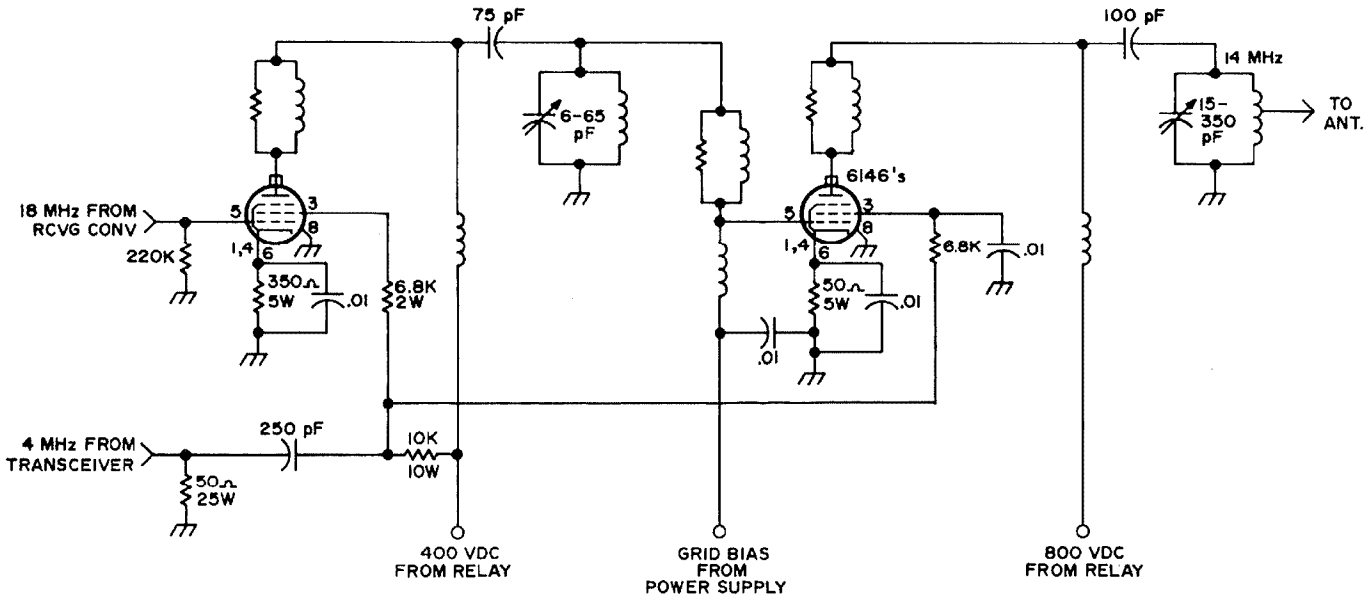


Fig. 5. Transmitting converter.

Figure 3 shows the power supply. Because my available control relays were 6V ac types, I decided to run a 6V line between power supply and transverter (as opposed to the usual 12V line). This practice can spell trouble unless the filament cable and the common return bus are of generous wire size. With relays energized and filaments lighted, the current averages 5A. Just half an ohm of interconnecting cable resistance can drop the filament voltage from 6.3 down to 4.6V, with resulting marginal operation.

Figures 4 and 5 complete the whole nine yards. Construction details are left to the builder's good judgment. From the experience gained in constructing this little gem, I would say that the most vulnerable part is the rf power amplifier following the high-level mixer. The 6146s are prone to parasitic oscillations. With 800V on the plates these tubes can disintegrate in short order. If my good friend Lew (W9YEA) had not sustained my needs by furnishing extra 6146s, I never would have been able to complete the project.

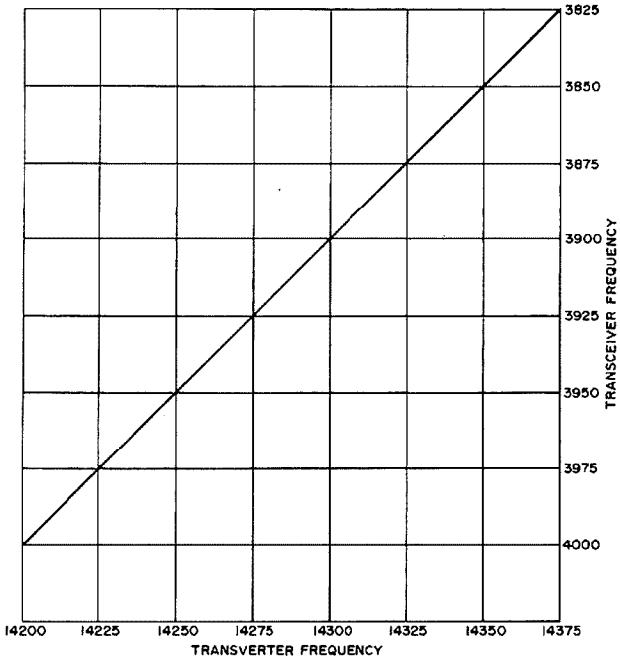


Fig. 6. Frequency conversion chart.

On December 23 my transverter was completed. On Christmas morning I worked VK3VG. On the 28th I contacted KZ5AB, and on the 29th, KH6AX. This is quite good considering the antenna, a dipole 25 ft up at its highest point – a dipole installed with the assistance of a loving and patient wife at night in a snowstorm.

You may wish to vary the circuit elements to suit the requirement, such as transverting from 20m to 75m, etc. One unique feature of this transverter is the high-level transmitting mixer, which works better than anticipated. Another bonus is the complete lack of birdies or images from the receiving converter. In fact, it is the first such converter I've built which exhibited such purity of output.

. . .W9IDP

Del C. Wininger WB6JNI
7400 Tiptoe Lane
San Jose CA 95129

A PRIMER ON LEDS

The surplus market is flooded with light emitting diodes (LEDs). They have some great characteristics and are easy to use.

What are they? They are diodes, they rectify just like any other diode but their atomic structure is such that when the electrons jump from one energy band to another they give off light. This is cold light and is intended to be seen only at the source, it is not for reading.

What good are they? Well, they withstand 1500gs vibration, they will last over a million hours without loss of intensity, they operate on low voltage dc, they come on in 35 nanoseconds, they can interface with any logic circuitry and be pulsed or driven steady state.

How do you use them? They operate on as little as two volts. The critical factor is the forward current. You must limit this forward current. This is done by putting a resistor in series with the diode. This resistor is calculated using Ohm's law:

$$R = E/I = \frac{\text{Voltage you want to use}}{\text{Current limit of the diode}}$$

A typical LED burns at about 15 mA; the more current the brighter it burns; this is a straight linear relationship. Some LEDs take 1 Ampere – if you use a heat sink.

The LED like any diode has a cathode (where you connect the positive lead) and an anode, the negative side. You take your ohmmeter and measure the forward and reverse resistance of the LED. When you find the connection with the lowest resistance that is the way you want to connect the LED in your circuit – in the forward direction. You can't hurt it with an ohmmeter.

There are many sizes and shaped of LED but they resolve into two distinct types: those with plastic lenses; and those with a flat face. The lens type is for viewing at a distance and directly in front of the display; and the flat face can be seen at the side more easily but not as brightly.

The first outgrowth of the LED was the opto-isolator. This is a LED and a light sensitive diode in combination. There are also LED-transistor and LED-SCRs. All of these come in a little 1/2 inch long package and they are used for isolating one circuit from another. This eliminates ground loops, transient spikes, and random noise. The difference in these three packages is the transfer ratio. The LED-silicon diode pair has a transfer ratio of 0.15%, for instance, if you put a 16 mA pulse to the LED you get a 24 mA pulse out. If you shunt the output with 42K ohms you have 1 volt to play with. The LED-transistor isolators have a transfer ratio that varies depending on the connection and biasing of the transistor but to get in the ballpark figure one to one transfer

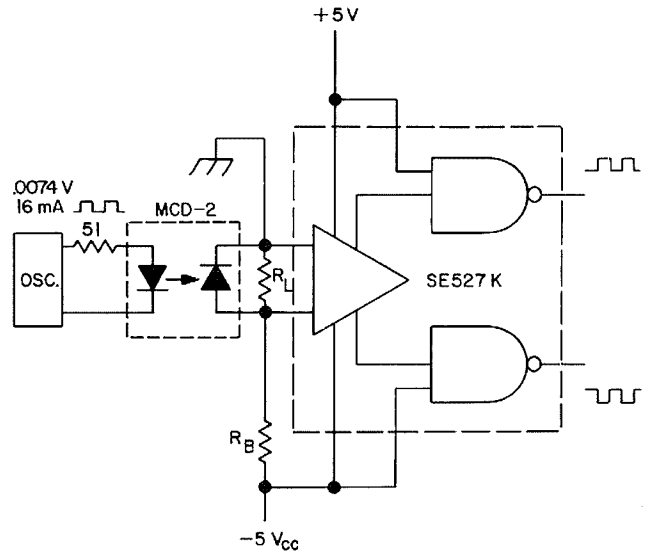
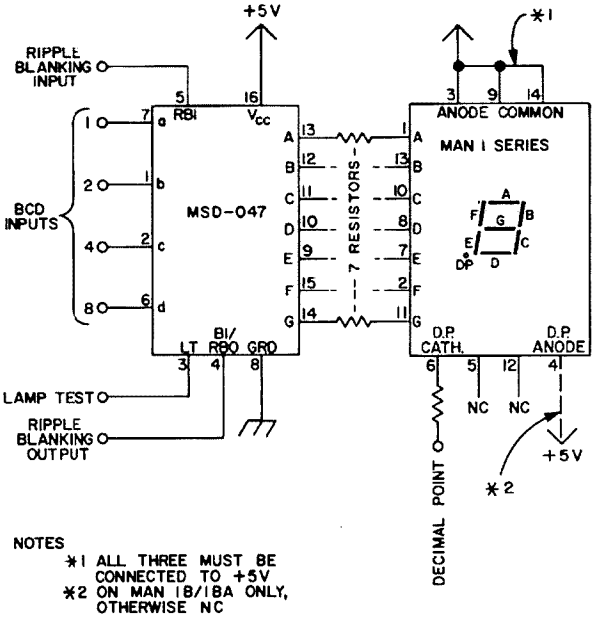


Fig. 1. Experimental implementation of MCD-2 for digital data transfer.

ratio. For instance 15 mA in gives 15 mA out. Why use diodes when transistors are so much better? The diodes are faster and they can transfer logic information.

The LED-SCR is a typical SCR and does anything another SCR can do like acting as a relay or switch except that it is triggered on by the light from the LED. This isolates it electrically from the input circuit.

The diagram shown in Fig. 1 shows a diode opto-isolator transferring a 1 MHz square wave from one circuit to another. In computer circuitry which is very sensitive to transients, this is a great thing. The load resistor RL was one K ohms and RB was the pull-down bias resistor necessary to operate away from the click point of the IC.



NOTES
*1 ALL THREE MUST BE CONNECTED TO +5V
*2 ON MAN 1B/1BA ONLY, OTHERWISE NC

Fig. 2. TTL decoder driver to MAN 1 series.

The next big step in LED complexity is the seven segment numerical display. I only mention this because so many are advertised in the surplus market. If you have one of these you need a decoder-driver that converts BDC information to the proper logic to activate the segments. They usually run on 5 volts and like the single LEDs, the segments must be current limited. Figure 2 shows a typical circuit. If this interests you, write to: *Monsanto, 10131 Bubb Road, Cupertino CA 95014* for their Product Directory and the proper application memos.

...WB6JNI

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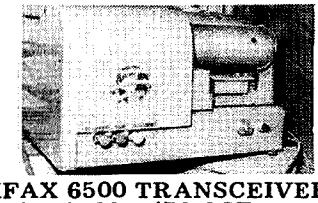
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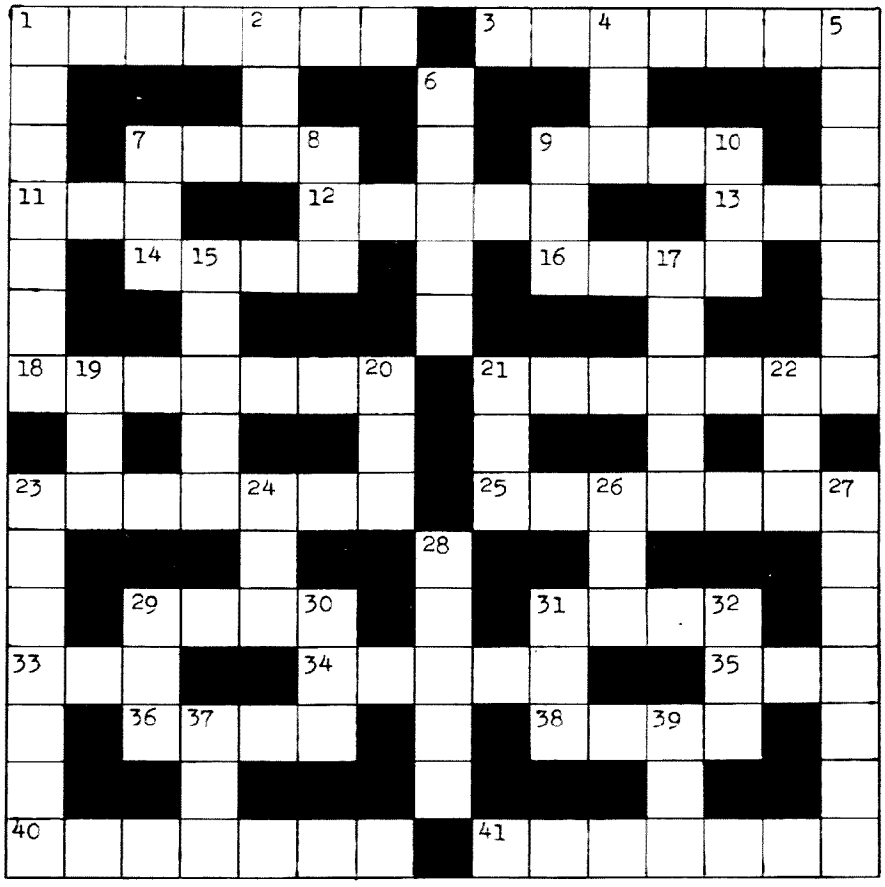
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ACROSS

1. A pulse that starts an action.
3. The core of an atom.
7. Any range of frequencies which lie between two defined limits.
9. The smallest portion of an element which exhibits all properties of the element.
11. A small low-voltage type incandescent lamp.
12. The element which receives the highest DC voltage in a cathode-ray rube.
13. An electrically-charged atom.
14. Also called derivative action.
16. A single unit capable of serving as a DC voltage source.
18. An expression of relations in an equation or formula.
21. A housing for a radar antenna.
23. A device having a scale calibrated to read directly in decibel values at a reference level.
25. A four-electrode electron tube.
29. A clue.
31. Short for synchronous.
33. A unit of conductance, which is the reciprocal of resistance.
34. A type of meter for measuring hearing ability.
35. The pickup device on a record player.
36. A connecting device.
38. A facsimile transmitter in which the copy is mounted on a rotating cylinder.
40. A plan or layout for a receiver.
41. The time taken by an electron to pass through a specified area.

DOWN

1. Three radionavigational stations operated as a group.

Michael Kresila
Box 57
Marion OH 43302

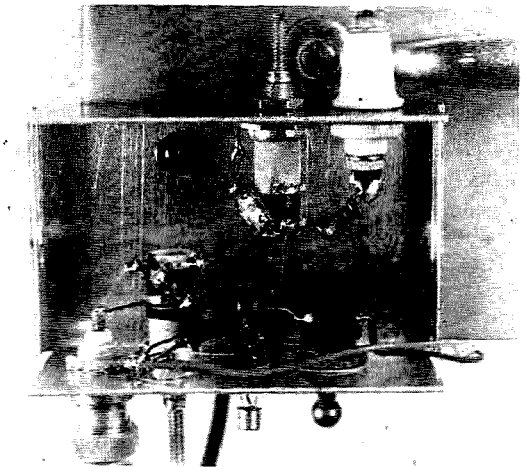
2. A firing weapon.
4. Sever.
5. In a facsimile transmitter, that which translates the densities of the subject copy into signal waveform.
6. The deadening of sound.
7. Special test pattern for adjusting color TV receivers.
8. Payable.
9. A luminous discharge of electricity through a gas.
10. A unit of measurement.
15. Identified on diagrams by the letter P.
17. A type of beam.
19. The center of activity.
20. To impair, spoil or blemish.
21. A small quantity.
22. Terminate.
23. Also called a rhombic antenna.
24. Metallic chemical element, At. No. 50.
26. Attempt.
27. Any component part of a vacuum tube.
28. Acronym for Carrier-Operated Device Anti-Noise.
29. An excursion of a radio wave from the earth to the ionosphere and back.
30. Also called a sentinel.
31. A surface layer of earth containing grass plants.
32. A sliding part used to convert rotary motion to linear motion, or vice versa.
37. A section or branch of a component or system.
39. A metal container with a faucet.

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FORTY METER FET PREAMPLIFIER

Here is a simple experiment used to familiarize yourself with FET circuitry. Described is a simple forty meter pre-amp which can be used to soup up a transistor shortwave receiver or add sensitivity to an inexpensive 80 or 40 meter receiver.

On several vacation trips I used 60 feet of wire wound on a dowel 3/8 in. in diameter, and then clamped to the car window. Without the pre-amp no signals could be heard even though a loading coil was tried, and several antenna tuning coils. Running coax back to the transmitter in the trunk and installing an antenna relay and control wires, converted me to this simple separate antenna installation with the pre-amp. No measurements were made on the gain, but it makes the difference between no signals and S9 results.



Bottom view of Pre-amp showing input and output coils and FET socket on the back.

Theory

Since this circuit was used just for the forty meter amateur bands, no attempt was made to use variable tuning condensers. The unit was peaked up by adjusting the slug tuning and left untouched.

The RCA FET used in this circuit is the 3N128. It is a high impedance device and is much like a vacuum tube in that it does not load down the coils like a transistor. In this circuit the antenna was attached to the top of the input coil through a 10 pF condenser because a random hunk of antenna wire was used. If the antenna had been a coax fed arrangement, several turns of wire could have been wrapped on the bottom of the coil for coupling. The output of the pre-amp is taken from five turns of number 23 wire into RG174 small coax to get the amplified signal over to the receiver.

The unit was built in an LMB box type 000, 3¼ x 2 1/8 x 1 5/8 in. The slug coils were 24 turns of number 28 wound on J.W. Miller ceramic 3/8 diameter forms, type

PROPAGATION CHART

J. H. Nelson

Good (Open), Fair (□), Poor (O)

DECEMBER • 1972

S	M	T	W	T	F	S
					1	2
(3)	(4)	[5]	(6)	[7]	8	9
10	[11]	12	13	14	15	(16)
[17]	18	19	20	21	(22)	23
24	25	[26]	(27)	[28]	29	30
31						

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
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ARGENTINA	14	7	7	7	7	7	14A	21	21	21	21	14A
AUSTRALIA	14	7A	7B	7B	7B	7B	7B	14	14	14	14	21
CANAL ZONE	14	7	7	7	7	7	14	21	21A	21A	21A	21
ENGLAND	7	7	7	3A	7	7	14	21	21	14	7B	7
HAWAII	14	7A	7	7	7	7	7	7B	7B	21	21A	21
INDIA	7	7	7B	7B	7B	7B	7A	14	7B	7B	7B	7
JAPAN	14	7B	7B	7B	7	7	3A	7	7B	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	21	21	21	14A
PHILIPPINES	14	7B	7B	7B	7B	7	7	7	7B	7B	7B	7B
PUERTO RICO	7	7	7	7	7	7	14	14A	14A	14A	14	14
SOUTH AFRICA	7B	7	7	7	7B	7B	14A	21A	21A	21	14A	14
U. S. S. R.	7	7	3A	3A	7	7B	14	14A	14	7B	7B	7
WEST COAST	14	7	7	7	7	7	7	14	21	21A	21A	21

CENTRAL UNITED STATES TO:

ALASKA	14	7A	7	3A	3A	7	3A	3A	7A	14	21	21
ARGENTINA	14	14	7	7	7	7	7A	21	21	21	21	21
AUSTRALIA	21	14	7B	7B	7B	7B	7B	7B	14	14	14	21
CANAL ZONE	14	7A	7	7	7	7	7A	21	21A	21A	21A	21
ENGLAND	7	7	7	3A	7	7	7B	14	21	14	7B	7B
HAWAII	21	14	7	7	7	7	7	7	7A	21	21A	21
INDIA	7	7	7B	7B	7B	7B	7B	7A	7A	7B	7B	7B
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PUERTO RICO	14	7	7	7	7	7	7A	14A	21A	21	21	21
SOUTH AFRICA	14	7	7	7	7B	7B	14	21	21	21	21	14
U. S. S. R.	7	7	3A	3A	3A	7B	7B	14	7A	7B	7B	7

WESTERN UNITED STATES TO:

ALASKA	14	14	7	3	3	3	3	3	7	14	14A	21
ARGENTINA	21	14	7A	7	7	7	7B	14	21	21	21	21
AUSTRALIA	21	21	14	7B	7B	7B	7B	7B	14	14	14	21
CANAL ZONE	14	7A	7	7	7	7	7	14	21A	21A	21A	21A
ENGLAND	7B	7	7	3A	7	7	7B	7B	14	14	7B	7B
HAWAII	21	14A	14	7	7	7	7	7	7	14A	21A	21A
INDIA	7B	14	7B	7B	7B	7B	7B	7	7	7	7B	7B
JAPAN	21	14	7B	7B	3A	3A	3A	3A	7	7	7B	14
MEXICO	14	7A	7	7	7	7	7	7	14A	21	21	14A
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PUERTO RICO	14	7A	7	7	7	7	7	14	21	21A	21A	21
SOUTH AFRICA	14	7B	7	7	7B	7B	7B	14	21	21	21	14
U. S. S. R.	7	7	3A	3A	7	7B	7B	7A	7A	7B	7B	7B
EAST COAST	14	7	7	7	7	7	7	14	21	21A	21A	21

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

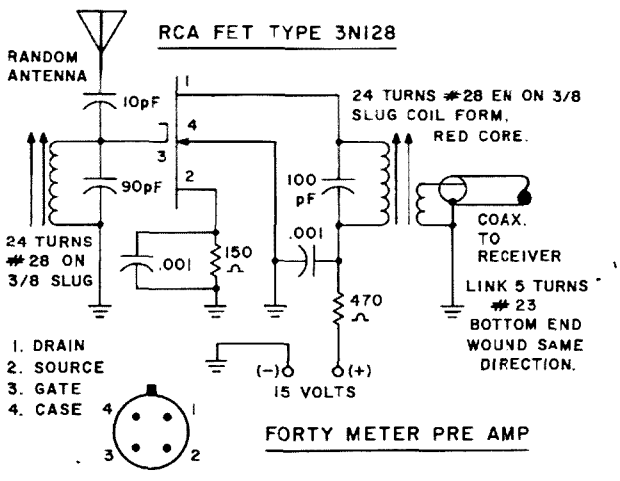


Fig. 1. Forty meter Pre-amp.

4400 or equivalent. These slugs are painted red and cover the 1.0 to 20 MHz range. The coils were mounted in the box as far from each other as possible. Normally there should be a shield between the coils to prevent oscillation, but the circuit was stable and no shield was necessary. If variable tuning condensers were used, the extra mass might suggest a shield because of more radiation in the area between the coils.

There are many stories about being careful when handling FET's, and I do not doubt them. No trouble was had with this unit. The case was held with the left hand, and the snippers held with the other, while cutting off the leads just below the shunt on the leads. Grabbing the shunt while still holding the case, it was slipped off and the leads formed to go into a transistor socket. The book says to use plastic tweezers and not to touch the FET because static charges from snippers might cause damage. Needless to say, you should remove the FET while soldering on the chassis. Wire it all up before putting the FET into place, and then push it in the socket with the power off, and I am sure you will have no trouble.

When the unit is finished, hook up everything and peak the slugs for maximum gain into the receiver. Generally the CW or phone portion of the band can be tuned without readjusting the slugs for any particular antenna. No attempt was made to try other bands. If you wind coils and dip them with a grid-dipper, there should be no problem.

. . .W6BLZ

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LIQUID PLASTIC WATERPROOFING

Strange as it may seem, the weatherproofing of a coaxial cable splice becomes a difficult problem especially when the splice is to be buried underground. Ordinary plastic electrical tape, over a length of time underground, will allow seepage of water between the layers.

We recently came across a system that has worked very well and that is the use of "Clear Cast" to encapsulate splices. "Clear Cast" is the trade name for a liquid plastic that turns very hard when a proper catalyst is added and allowed to "cure." In its original application, Clear Cast is used for hobby projects such as molding, etc.

In using Clear Cast for sealing coax splices, a cardboard tube ½ in. larger than the coax is placed over the splice. The end of a small balloon is placed over the coax and stretched over the end of the cardboard tube. Of course the splice is opened to put these items in place. The coax is then suspended in a vertical position with the balloon "seal" downward. Clear Cast is then poured in the cardboard tube so as to surround the splice. The hardening catalyst must be added to the Clear Cast before pouring. Correct amounts of hardener or

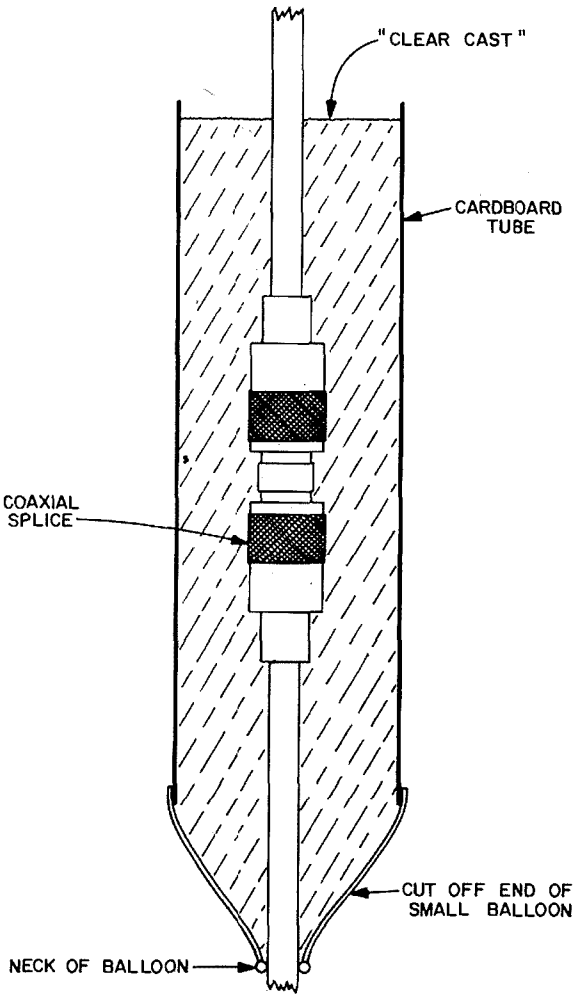


Fig. 1. Coaxial splice waterproofing.

catalyst is prescribed on the container that the Clear Cast comes in. During the hardening process, a fair amount of heat is generated due to the chemical reaction. Approximately six to seven hours are required for complete hardening. Strange as it may seem, the smaller amounts of Clear Cast require longer times to "cure." The larger casts generate more heat and apparently cure faster. Once hardened, the cardboard tube and balloon can be removed leaving the sealed coaxial splice (see Fig. 1).

Clear Cast also works well as a mechanical stabilizer for vfo and other oscillator coil assemblies. A small plastic box, just larger than the coil to be encapsulated, is used as a mold. The coil can be suspended by strings (or whatever means you desire) to a central position in the plastic box. The Clear Cast is poured and allowed to harden. The Clear Cast holds the coil extremely rigid eliminating much mechanical vibration and partially insulates the coil from temperature change. The Clear Cast form can be drilled and tapped to securely mount the coil to a chassis (see Fig. 2).

A third application for this liquid plastic is to encapsulate, insulate and support the vertical element of a ground plane antenna. Again the balloon technique is used to seal in the plastic while in a liquid state. Prior to encapsulating, the coax center conductor is attached to the vertical element and the shield braid is soldered to the copper tubing (see Fig. 3). At this point also, the ground radials should be soldered to the copper tube. The balloon seal is stretched into place and the Clear Cast poured in the top. The plastic hardens and seals the coax and vertical element in place (weatherproof) and insulates it from the copper radial support. The entire assembly is mounted by the use of stainless steel straps to the mast.

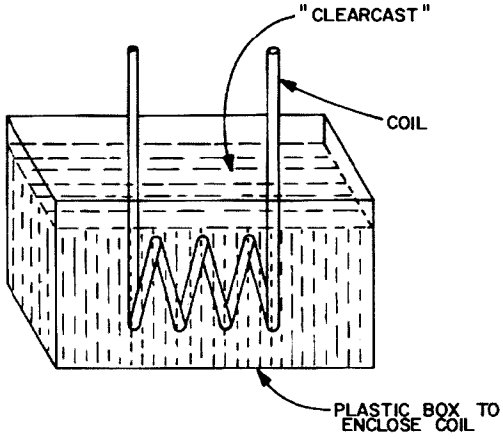


Fig. 2. VFO coil stabilization.

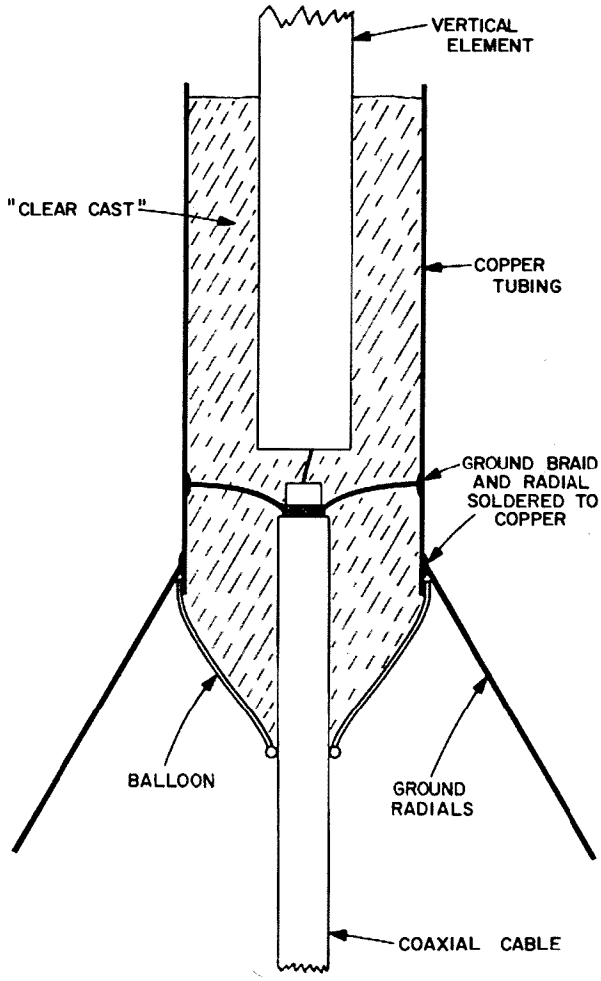


Fig. 3. Ground plane vertical insulation.

If you are using a gamma match type of beam, it might be possible to encapsulate the gamma capacitor to protect it from weather. Of course if you encapsulate the entire capacitor, plates and all, you would have to experiment with the dielectric effect of the Clear Cast when poured between the capacitor plates. Another possibility is to form a "cavity" in the Clear Cast so the capacitor would be variable yet protected.

No doubt once you have experimented with this liquid plastic you will come up with many more applications.

. . .W2AOO

Note: "Clear Cast" and hardener may be obtained from: *American Handicrafts Company, 680 Main St., Buffalo, New York.*

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San Jose CA 95129

IMPROVED CIRCUITRY FOR KTI CW FILTER

A recent article (*Ham Radio*, August, 1970), described the use of the KTI – Kinetic Technology Inc., 3393 De La Cruz Boulevard, Santa Clara, California 95051 – integrated circuit active filter as a selective audio filter for CW reception. The suggested circuit diagram is shown in Fig. 1. The author constructed this circuit and found it to be a very selective filter, but with certain reservations. At high Q or narrow bandwidth the received signal was difficult to control; the gain of the filter varied inversely with bandwidth, requiring constant readjustment of the receiver gain control.

I discussed this problem with Mr. Fred Glynn, Western Regional Sales Manager for KTI, and he suggested the circuit shown in Fig. 2. He also suggested that I use their Model FX-60 active filter (Amateur class FS-60, $4.95). This circuit works fine and is a pleasure to use. Now the filter has unity gain regardless of bandwidth, i.e., once a

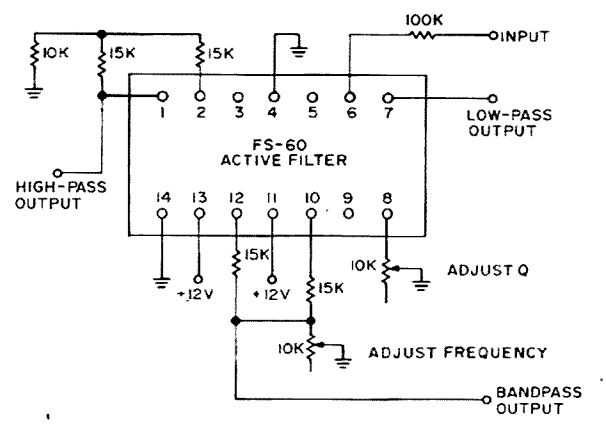


Fig. 1. Original active filter circuit using the FS-60 as it appeared in Ham Radio Magazine.

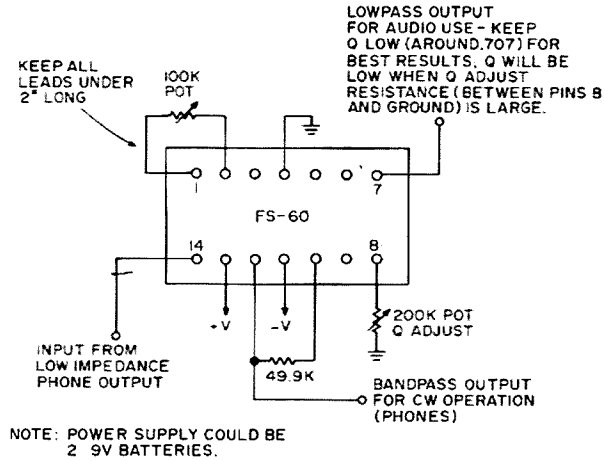
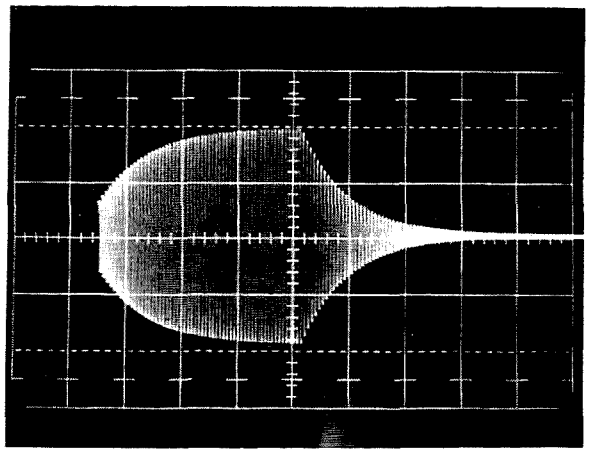
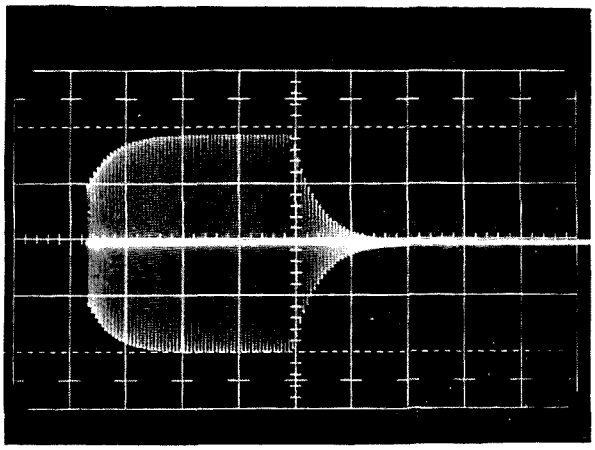


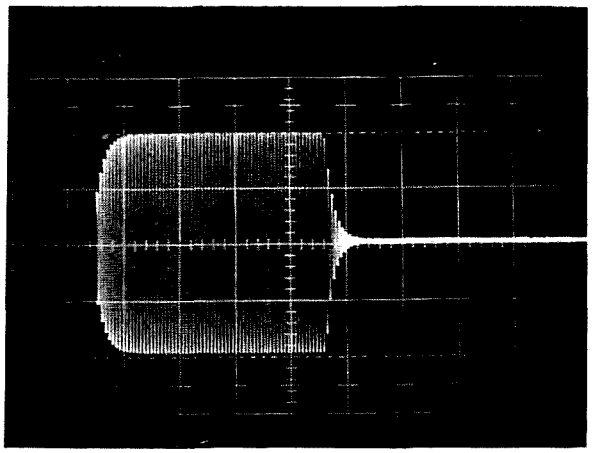
Fig. 2. Modified active filter circuit.



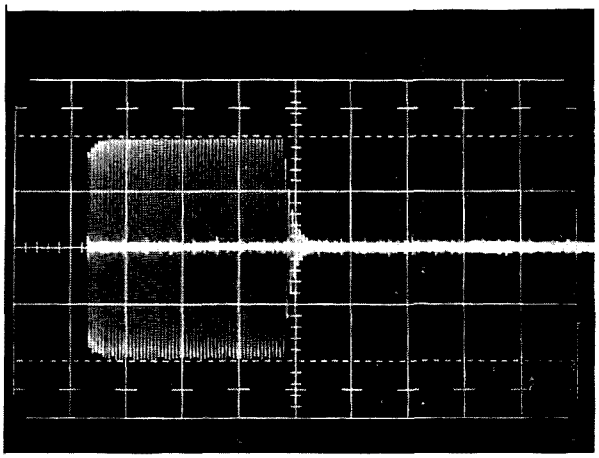
3 dB bandwidth 30 Hz. fo = 800 Hz



3 dB bandwidth 60 Hz. fo = 800 Hz



3 dB bandwidth 100 Hz. fo = 800 Hz



3 dB bandwidth 200 Hz. fo = 800 Hz

Keyed signal characteristics as function of filter bandwidth, horizontal scale 20 msec/cm.

signal is peaked, QRM can be eliminated by means of the Q control. On 80 meters, increasing the Q eliminates most of the background QRN.

One of the inherent problems associated with a selective filter used with a keyed signal is the effect of filter bandwidth on the "sound" or "crispness" of this signal. As the bandwidth becomes very narrow, the filter requires more time to reach equilibrium. As a result, at narrow bandwidths the received CW signal will become distorted as shown in the photographs.

It can be seen that at 30 Hz bandwidth a 70 msec keyed signal takes nearly 70 msec to reach full amplitude and to decay to zero. This signal would not sound too good at a high CW word rate. As the bandwidth increases, the filter output waveform closely approximates the input wave form.

I have used this filter in conjunction with a Hammarlund SP-600 receiver. I can obtain as good or better selectivity and intelligibility with this audio filter and an i-f bandwidth of 13 kHz as I can without the filter and an i-f bandwidth of 200 Hz (excluding single signal effects).

In addition to selectivity, this filter provides the operator with a separate tuning control within the audio bandwidth. Signals can be selected, peaked and interference eliminated without adjustment of the receiver frequency control or bfo. I believe that the CW operator will find this filter a useful adjunct to his receiving equipment.

. . .W6AGX

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Sandwich IL 50548

A TRANSISTORIZED VFO

A perfect project for the newly liberated novice. The circuit is assembled on a printed circuit board for ease in construction.

The problems encountered in the design of a variable oscillator for use in amateur transmitter frequency control are manifold. The circuit must be stable electrically and the mechanical design must be such that the oscillator frequency-determining components are mounted in a rigid fashion. The design to be presented satisfies both requirements and utilizes a rather simple but effective mechanical layout.

In addition to electrical and mechanical considerations, thermal transients are responsible for much of the short term frequency variation encountered in normal operation. The use of transistors and a well mounted toroidal inductor in the tuned circuit does much to eliminate these short term frequency changes.

Circuit Description

The oscillator is the familiar Clapp circuit so often used in amateur vfo applications. It is different from most in that the oscillator is amplitude limited resulting in a low and constant level of oscillation. Q2 is an emitter follower and isolates the oscillator stage from Q3 and the output amplifiers. Q3 is a dc amplifier that supplies bias to the oscillator transistor; an increase in the level of oscillation drives Q3 further into conduction which in turn lowers the base bias on Q1 stabilizing the level of oscillation at a constant value. This results in true class A operation for Q1, a condition which is seldom met in a fixed bias oscillator. It will be noted that the output of the oscillator stage is further isolated from the rest of the circuitry by coupling off the collector of Q1 rather than from the tuned circuit as is usually done. This results in extremely good isolation between the frequency determining elements and the rest of the vfo.

Q4 and Q5 are straightforward amplifiers to raise the output of the oscillator to a usable level. With a nine volt battery the output at the collector of Q5 was more than adequate to drive my home built vacuum tube transmitter which contains an untuned buffer amplifier between the vfo and frequency multiplier chain.

The oscillator coil, L1, is wound on a 1/2" toroid core and the rest of the tuned circuit consists of a variable tuning capacitor shunted by a silver mica padder and two silver mica capacitors in the feedback loop.

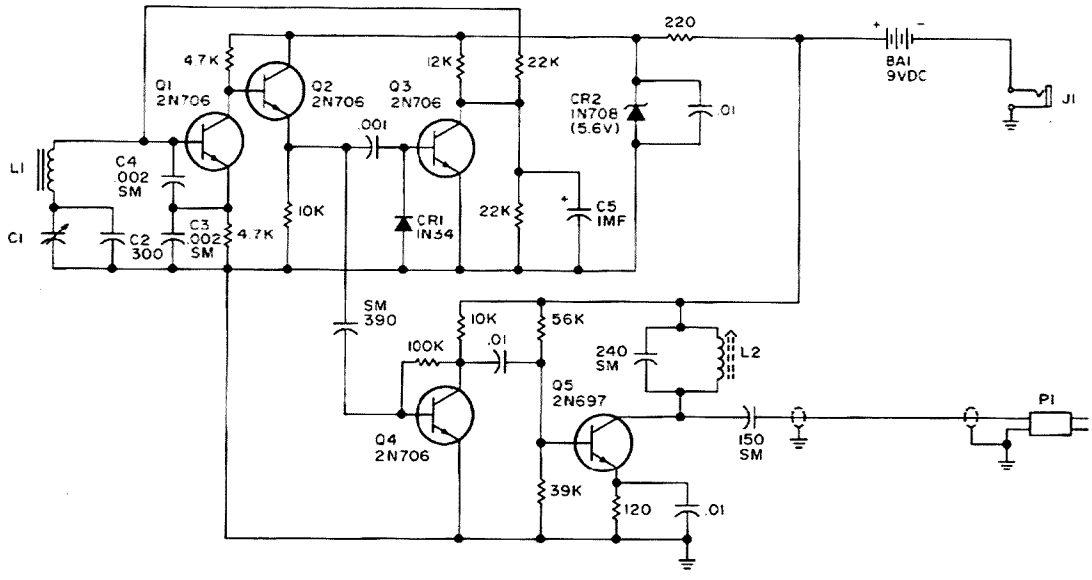


Fig. 1. Schematic diagram of the transistorized vfo.

Schematic Diagram Notes

L1 – toroid coil 1/2" od 'E" material core. Amidon associated core T-50-2. Winding 45 turns number 28 enamel wire spaced over entire core.
C1 – 100 pF maximum variable capacitor. Johnson type S 148-6 or equivalent. Remove plates as required to provide desired bandspread.
C2 – Silver mica – approximately 300 pF. Adjust exact value to set lower tuning range to 3.5 MHz.
C3, C4 – Silver mica 2000 pF.
C5 – Miniature electrolytic 1 μF at 10 VDDW.
L2 – 40 turns number 28 enamel wire on 3/8 diameter slug tuned form.
CR2 Zener diode, 1N708 – 5.6 volts. (Motorola HEP-103 useable)
BA1 9 volt transistor battery
J1 Miniature jack
P1 Two prong plug with standard .486 pin spacing for crystal sockets or other to match companion transmitter.
Q1, Q2, Q3, Q4 2N706
Q5 2N697

These were .002 μF in the unit built, but their value could probably be increased to result in even more decoupling of the tuned circuit from the oscillator transistor.

Coupling off the collector of Q5 requires that the load for the vfo be a high impedance such as the grid of a vacuum tube amplifier or frequency multiplier. For low impedance output a link wound over the B+ end of the L2 should do the job if it is necessary to drive a coax line.

The supply voltage for the first three stages is regulated by a zener diode. With a battery power supply in fixed station service this is probably not absolutely necessary, but the zener does provide a convenient means of supplying the first stages with a constant supply.

Mechanical Design

The mechanical layout of a vfo is extremely important if variations in frequency due to shock and thermal changes are to be avoided. Many methods have been used and some have gone to rather elaborate lengths to achieve mechanical stability. With transistors and a printed circuit board for the layout the mechanical design is simplified. The circuit board ties down the wiring and all the components except the coil and tuning capacitor. It then remains to devise suitable mounting arrangements for these two.

The toroidal coil is handled by connecting it to the circuit board and then encapsulating it and its leads to the board with epoxy cement. This provides a very rigid mount mechanically and is quite simple to use. In addition to the coil, the three silver mica capacitors in the tuned circuit are spoxied to the circuit board to enhance their machanical rigidty. This expedient is probably not absolutely necessary, but the excess epoxy from the coil fastening operation can be well used here.

The mechanical mount for the tuning capacitor is often the shortcoming of an otherwise good vfo. Since the epoxy used to hold down the coil and capacitors on the

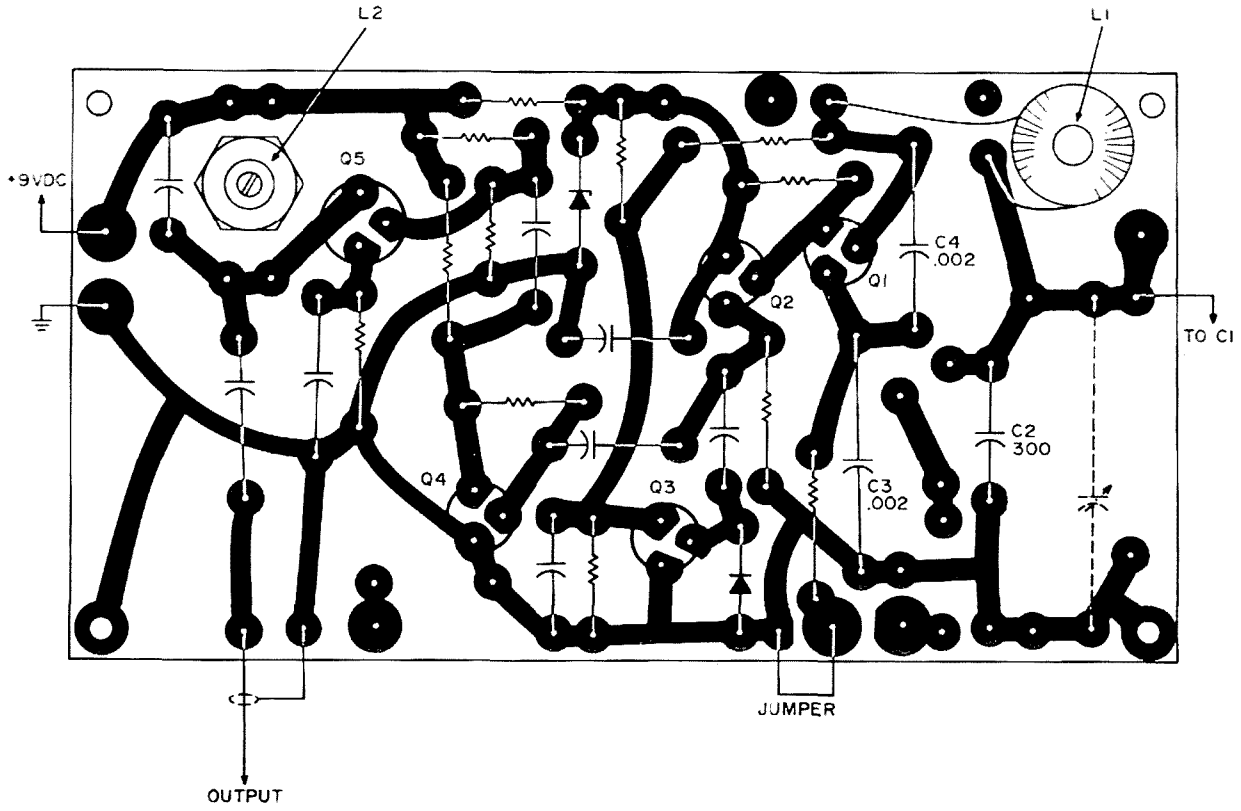


Fig. 2. Circuit board and parts placement for the vfo. Major values are noted to serve as a key.

circuit board proved to be so sturdy, I reasoned that it might also be used to mount the variable capacitor. The shaft of the capacitor is mounted to the vernier dial coupling and its ceramic body fastened to the chassis by a liberal application of epoxy through a hole approximately 1/2" in diameter immediately above the capacitor. A sketch of the mounting arrangement is shown. A mounting bracket would probably work, but the direct chassis mounting eliminates the mechanical variations which might be present in a secondary connecting member.

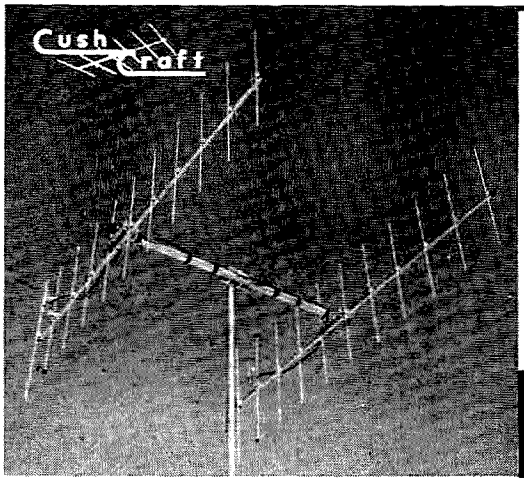
I obtained the epoxy used throughout at the local hardward store; it's sold under the trade name "E-POX-E STEEL." [1] Preliminary tests on a sample showed that it did not cure very well when allowed to dry overnight as suggested in the directions, but a test cure in the kitchen oven at 200F proved to be quite good, and the drying time at the elevated temperature was under a half hour. Some capacitance is added to the toroid coil by the encapsulant so final padding adjustment on the tuning must be done after the coil is epoxied in place.

I suggest that the printed circuit board layout be used as shown. The wiring can get quite complicated without a circuit board, and point to point wiring can be unstable for vfo use. I made no attempt at miniaturization in laying out the board and it could have been smaller. The size was chosen to be compatible with the remainder of the station gear and the dial on the vfo itself.

Once the board has been assembled, the remainder of the wiring is minimal with the only connections being to the variable capacitor, the battery and the output cable. It will be noted that some unused holes are shown on the board. These are a result of some ideas which did not work out in the final circuit design. One of these necessitates jumpering the emitter resistor of Q1 to ground (see reference to oscillator keying below).

The assembled circuit board is mounted on top of a standard minibox which is 3 X 5¼ X 2" high. A hole must be drilled in one corner of the top of the box to clear the output slug tuned coil. Mounting the board on top leaves the inside open for the tuning

[1] Woodhill Chemical Corporation, Cleveland, Ohio 44128.



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capacitor and the battery. The vernier dial is mounted to the front apron of the box and the output cable exits at the rear with a jack on the rear apron for external control of the oscillator.

The battery mount was made using the top of an old battery soldered to a terminal strip. The nine volt battery then plugs into this arrangement. While this mounts the battery simply, a more rugged mount would be more suitable for mobile use.

Results and Conclusions

One of the problems I encountered with the vacuum tube circuit this vfo has replaced

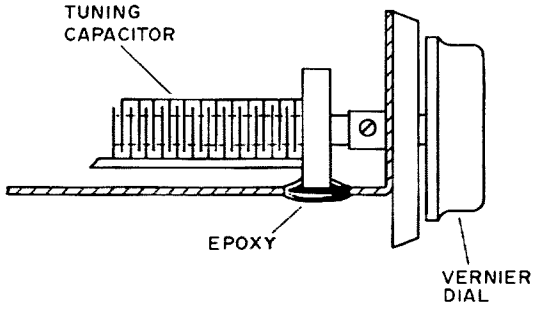


Fig. 3. Details of rigid capacitor mount.

was a slow thermal drift each time the oscillator was turned on during a QSO. This sort of short term frequency variation is common with tube circuitry and high levels of oscillation. Drift with the semiconductor vfo is practically non-existent on both a short and long term basis.

In normal operation the vfo is allowed to run continuously and a subsequent stage in the transmitter is keyed. This does not allow break-in operation although the vfo has been keyed and only a very slight chirp can be detected. The chirp is dependent on the load presented by different settings of exciter tuning and suitable adjustment of the multiplier stages does eliminate the chirp almost entirely. This sort of arrangement is by no means a sound solution to the chirp problem, however, and for best operation you should run the vfo continuously or provide a suitable method of differential keying.

This vfo should be used to drive a frequency multiplier in the companion transmitter and not straight through on 3.5 MHz. For eighty meter operation, a half frequency design of 1.8 MHz should be built. Since I wanted operation only on 40 meters and above I chose the 3.5 MHz output frequency.

The above precautions are almost standard practice for ham vfo's, and the many attempts to bypass them have been futile. In other words, the old handbook warning against trying to key a vfo still holds.

This oscillator has been a very worthwhile replacement for the old tube model in the station transmitter. As mentioned, the output was adequate to drive my rig, but some transmitters in the Novice class might require a little more drive. The output level is dependent on supply voltage; increasing the battery to 12 or 18V will provide additional drive. However, the supply should not be much over 20V unless a 2N697 is used at Q4 in place of the 2N706 shown on the schematic diagram. Different bias resistors for Q5 as well as a larger dropping resistor for the zener diode would be required if the supply is increased. An untuned vacuum tube buffer amplifier might be more effective to couple into an existing transmitter if the output of Q5 is not enough alone. ...W9ZTK



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Design & use Part IV—K3PUR 43 Oct TH38
Pwr lead filter for 432—K1CLL 83 Oct VH39
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Transmitters then & now—W2FEZ 35 Aug HI5
$5 preamp compressor—VE3GSP 75 Aug TX19
SCR reg KW pwr sply—W3HXO 107 Aug TX21
Power lead filters for 432—K1CLL 83 Oct VH39
Solid st power—W6EI 15 Nov TX25
Line oscillator VFO—W6HDM 69 Nov TX27
Minimod—G3ZCZ 202 Nov TX30
10m solid state—W6OSA 207 Nov TX32
Aural xmtr tuning aid—W1KPN 305 Nov TX34
Transistorized VFO—W9ZTK 112 Dec TX37

TVI
Low pass filter in action—VE3GSP 115 Mar TX14

UHF
1296 MHz mixer—WB2YVY 33 Jul UG1

VHF
Dummy load wattmeter—K9STH 46 Feb TX3
SS tuneable i-f II—K1CLL 33 Mar VH1
6m mobile xmtr—Martens 21 May VH6
VHF freq counter—K2OAW 53 May TE14
20 dB beams—K1CLL 67 Jun AN27
300 MHz freq scaler—K2OAW 97 Jun TE18
VHF counter—K2OAW 5 Jul TE26
SS VHF amplifier—W9ZTK 15 Jul FM59
VHF converters—W8RHR 23 Jul VH9
VHF repeaters Europe—W2EEY 37 Jul FM62
Meteor DXing—W5KHT 71 Jul VH13
Diode rcvr for 432 MHz—K1CLL 65 Aug VH17
Push-to-talk for sixer—WB2YWO 77 Aug VH10
VFO operation for twoer—WB6FVW 89 Aug VH22
Ideal crystal oscillator—K1CLL 115 Aug VH23
FM adapter—W1LE 119 Aug FM79
Exploring microwaves—K1CLL 38 Sep VH24
VHF freq counter—K2OAW 39 Sep TE38
SS 6m crystal HET-VFO— 29 Oct VH30
Power lead filters for 432—K1CLL 83 Oct VH39
220 MHz front end w/FETs—K1CLL 45 Nov VH42
SSB on 432 MHz—WA8VHG 163 Nov VH45
Minimod—G3ZCZ 202 Nov TX30
One converter two receivers-W1OOP216 Nov RX37

MORE LETTERS

It was very gratifying to see my latest article on SSTV equipment in print in the September issue of 73 Magazine. I am already receiving many compliments on it and that 73 is publishing timely articles on SSTV. From the correspondence and conversations with chaps who are building this camera I have been getting several questions in regard to the Plumbicon deflection coils.

In the diagram the horizontal sync pulse drawn near Q4 is 5 *milli*seconds, not 5 microseconds. The vertical sync pulse drawn near the diode of Q6 is 45 *milli*seconds, not 45 microseconds. In the upper right hand paragraph above the schematic Fig. 4, the third sentence should read as follows: *Each horizontal coil has approximately 620 turns of #36 wire.* The fourth sentence should read: *Each vertical coil has approximately 800 turns of #36 wire.*

I would also like to add that the .050 inch thick deflection coil form is used for the vertical coils during winding. A form of the same dimensions but only .030 inches thick is used as the window opening form for the horizontal coils. This second window form was omitted from the article.

That is about all the comments from K7YZZ for now, Wayne. See you on 20 SSTV sometime soon, I hope.

Louis I. Hutton K7YZZ
Bellevue WA

We have some very, very dishonest fellow amateurs on our airwaves. I happened to be working a very chirpy Novice lately and I reported to him what I was hearing. We spent about 30 minutes discussing his chirp problem and the possible causes of it. He reported that I was the first one to tell him that he had chirp and thanked me for telling him. I heard the same guy a few nights later, and his beautiful ac chirp was still there. I called him and he did everything but call me a liar, saying he had asked almost everyone whom he had worked since our first QSO and was told his signal was very clean, with no trace of chirp. Now the guys that he had worked were either lying to him or very ignorant, not to know a very noticeable chirp when they hear one.

I just cannot believe these guys would lie to him. If my signal sounds lousy, I want you to tell me and I'm sure going to tell you if yours sounds lousy, hopefully before the FCC does, because that's the worst way to find out. So come on, guys, let's help each other out and most of all let's help out the beginners, because they need the help the most, especially now that they will be using VFO's at least 50% of which will probably be ancient drifters that are cheap and easy to come by. Spend a little time working the Novice bands and let's get them started out on the right foot.

Steve Morgan WA8QNR

Nothing special (i.e., no axe to grind) but thought I would mention that I feel the Sept. 72 73 just received is one of the best balanced (opinion, articles, scope, etc.) to date — and real pro. appearance.

Will Rassbach WA7GRN
Seattle WA

I just thought I would include a little note to let you know that my selection of your magazine was not just chance. I have seen and read all the leading ham publications. I've even been given a free 6 month subscription to C.Q. As far as I am concerned they just don't match up to yours, for good, overall total information on the "state of the art." I enjoy the columns on most all subjects, but I would like to see more in the way of operating hints for Novices. Like tips on DXing, antenna systems, and just overall coverage for the newcomer.

William Armstrong WN8NKT/4
Shaw AFB SC

With reference to the October issue, I read with interest W2GOM's explanation of how a Clapp oscillator works. It is amusing to note that the model he develops couldn't possibly oscillate without a 180 degree phase shift, a point he was trying to refute! Although a crystal, by itself, can't develop a 180 degree shift, in combination with the other capacitors in the circuit it can and does.

That tutorial article should be interesting.

Gilbert L. Boelke W3EUP
West Seneca NY

I'm with you on the Amateur Extra Class license. While in high school in 1925 I got a 1st Class Telegraph, followed by a 1st Class Fone. Worked at them both, even after I went back to school for an engineering degree several years later. Present call acquired in 1932, Class A, then Advanced. Have worked over 45 years in amateur radio, AM, SSB, CW. Kept current in all. Why should you, I, or any serious, knowledgeable amateur, be penalized? I believe the FCC action, sponsored by ARRL, is discriminatory. While I would have no trouble with the exam, including code, I refuse to take it.

J. Alan O'Neil W6GIX
San Francisco CA

I am a collector . . . I collect magazines devoted to amateur radio. Mine is not a large or particularly exotic collection, but I think you might be interested in a portion of its contents. The most expensive single copy I have is an Aug. 72 issue of "rpt." I paid $6 for it. I didn't intend to pay that much for the issue, as I was led to believe there would be 23 subsequent issues included in the price.

I also have a similar issue of "FM" which also seemed to cost a larger amount than I intended to pay.

As of this date, I am not a regular subscriber to 73. I found that several years ago I received several free issues of 73 after paying so much for my "FM" issue; and, it is said that history has a way of "rpt"ing itself.

I doubt very much that I will continue to collect limited editions . . . they are getting too expensive.

Dave WB9DNI/WA7GSG
Aurora IL

P.S. Have you heard about the new publication devoted to Citizens Band Repeaters? I believe it will be published in Michigan, by a former amateur.

No, no free issues of 73 this time. And, if you'd read 73 or the Repeater Bulletin you would have been warned that special interest magazines are a big gamble as far as subscriptions go. Many thousands of amateurs have been taken in the past short-lived publications. If you watch 73 carefully, you will find that we do not recommend publications that look like they are not going to be able to make it.

DXer Magazine will make it. We run ads for Gus and his nice little publication because we know that he is going to be there and that readers who depend on 73 will not be disappointed. World Radio looks good — and is fun to read. I don't know how Armand gets all those interesting DX stories, but he does. . . .wayne.

The FM bug is following quite closely. I recently acquired an RCA Carfone CMV-4F xmtr-rcvr single frequency, presently on 154 MC and modified for 12V. I plan to remove the dynamotor and vibrator. I have a power supply which is adequate for base station use. I also have a manual. I would appreciate any info concerning conversion to 2 meters.

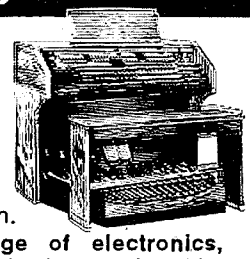
Although I am only a Novice I hope someone can give me a little help. I am working for my General license now.

Also I was considering using the Carfone on 2 meter CW by grid block keying a couple of xmtr stages. Comments on this by anyone would be appreciated.

Richard L. Gagnon WN3RUB
903 Cedar St.
Pocomoke City MD 21851

Continued on page 146 . . .

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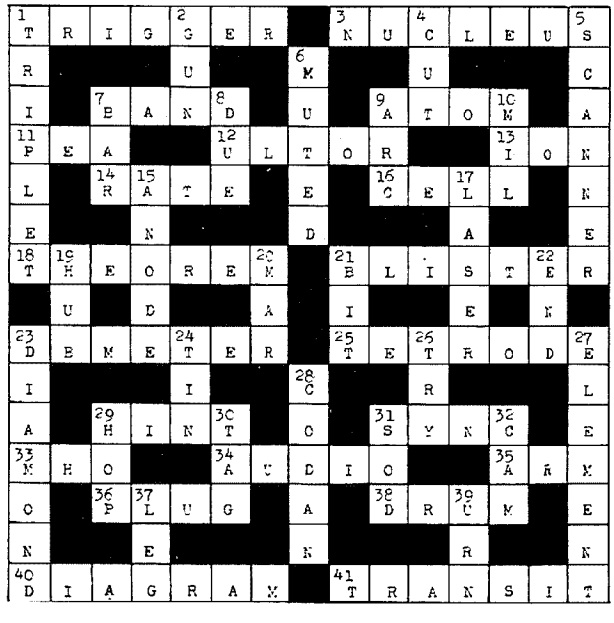
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ANSWER TO CROSSWORD PUZZLE

on page 99 of this issue



SOLUTION TO CRYPTOGRAM

on page 117 of the November issue, a quote from W2NSD's editorial in that issue:

> The heavy hand of an insensitive government has just dealt a cruel blow to the most exciting and fun aspect of amateur radio in many, many years.
>
> Wayne Green

NEW NOVICE REGS

In the Matter of Amendment of Part 97 of the Commission's Rules to provide for expansion of the telephony segments of the high frequency amateur bands.

Adopted: September 27, 1972;
Released: October 2, 1972
By the Commission: Commissioner Johnson concurring in the result.

1. The Commission adopted a Notice of Proposed Rule Making in the above entitled matter on February 24, 1971, which was published in the Federal Register on March 6, 1971 (36 FR 4511). Interested persons were invited to file comments on or before June 1, 1971, and reply comments on or before June 18, 1971, respectively. The Notice proposed to expand the General-Conditional Class sub-band operator privileges in four amateur radio high frequency bands, to provide additional Amateur Extra and Advanced Class sub-bands in those high frequency bands where they do not exist, and to make other adjustments to the allocations of high frequency bands to facilitate the accomplishment of these proposals and additionally to expand the telephony sub-allocations in the five amateur radio high frequency bands from 3.5 to 29.7 MHz.

2. Formal comments were received from persons and amateur radio organizations within the United States and foreign countries. Many comments simply urge the adoption, or the rejection, of the proposals. Others endorse certain proposals and request that others not be adopted. Many propose alternate frequency band allocation plans. Since the comments received were so numerous, it is not practicable to discuss each herein. However, every comment filed has been given careful consideration.

3. Reactions to the proposals expressed in the comments, were highly mixed. Some, identifying themselves as telegraphy enthusiastis, opposed the proposal, usually citing the resulting reduction in the effective use of the telegraphy bands as the reason. Others, identifying themselves as telephony enthusiasts, supported the pro posal, usually giving the crowded telephony bands as the reason. Proponents of both sides of the issue agreed that telephony expansion would be at the expense of telegraphy operation, with the telegraphers aruging that their preferred mode of radiocommunication would be impaired and the telephony advocates aruging that telegraphy is outmoded and unnecessary.

4. All of the HF bands from 3–30 MHz have predictable propagation characteristics depending on the period of the sunspot cycle, season, time of day, and the order of the frequency band itself. At times, some bands are primarily useful for short-distance radiocommunication, even though under those circumstances signals cross national boundaries. At other times, even the two main lower frequency amateur bands (3.5, 7.0 MHz) become international in character through long distance ionospheric propagation of signals. During the low period of the sunspot cycle, congestion in the lower frequency bands becomes more critical as the maximum usable frequency (MUF) decreases. Bands above 14 MHz, are generally considered internationa in nature by reason of long distance propagation of signals in these bands for a large percentage of the time.

5. A considerable number of comments were received from organizations located in other countries, and a delegation from one country paid an official visit to the Commission to discuss the ramifications of the Notice. The comments and information of other countries are worthwhile, and provide an added insight to what is normally considered a domestic matter. It is recognized that there are no formal internationally agreeed sub-allocation plans which reserve certain portions of any of these bands for one type of emission or the other. There are, however, "gentlemen's agreements" among amateurs in various parts of the world (Region 1 in particular) which have worked out well in practice in maintaining order and providing efficient utilization of the various amateur bands. Only a few countries, having large numbers of amateurs, provide sub-allocations in domestic regulations. The International Radio Regulations, to which the United States is a signatory administration, provides only band allocations to the Amateur Radio Service for the three Regions. In reaching a judgment on a matter with implications which could result in a lessening of international good will among amateurs, as well as a reduction of efficiency of utilization of the spectrum, we would be doing amateurs generally a disservice were we to disregard physical phenomena. Certainly we would be short-sighted if we totally disregarded opinions such as that of the International Amateur Radio Union, Region 1 Division, which pointed out,

> "The downward shift to 14,150 kHz will cause severe interference to operation in Region 1. With the high power and large number of US stations it will not be possible for foreign stations to operate above 14,150 kHz when propagation conditions enable USA stations to be heard. The consequent move downward in frequency by Region 1 Telephony stations will undoubtedly cause breaches of the voluntary IARU Region 1 band plans which have been in satisfactory operation for a number of years."

A similar opinion was expressed by the Radio Society of Great Britain and others.

6. Therefore, we conclude that a significant expansion of the telephony segments within the high frequency amateur bands would be at the expense of the telegraphy segments. Furthermore, we are of the opinion that the traditional amateur telegraphy radiocommunication mode must not be compromised. The rationale for this conclusion is well summarized in a quotation from a letter to the Chairman of the Commission from the Director of the Office of Telecommunications Policy:

> "While the use of CW radio telegraph communications has been replaced in most radiocommunications services with more sophisticated techniques over the years, this is not considered sufficient reason to justify the curtailment of such operations among U.S. amateurs. Knowledgeable communicators agree that when other types of high frequency radiocommunications fail CW transmissions are likely to get through. Thus, even though other techniques might be relied on first, it still would be wise to retain a pool of U.S. citizens skilled in CW operations as a resource in reserve. Amateur operators, with their past superb record of serving the public interest when needed, are considered the best means for preserving this skill."

7. We find that amateurs have been resourceful in effectively operating in the overcrowded high frequency bands. The vast majority have adopted spectrum conservation receiving and transmitting techniques. The nearly

universal incorporation of suppressed or reduced carrier types of SSB emission and other frequency conserving capabilites, such as highly selective receivers and directional antennas, has permitted more operators to conduct reliable radiocommunication over greater distances. Nevertheless, the question of how the existing high frequency amateur bands can accommodate even a relatively modest increase in the number of stations is now clearly in view. As evidenced by the petitions and comments, even the present number of amateurs authorized for telephony emissions on the high frequency bands at times far exceeds the capacity of the allocated A3 and F3 emission segments. We see no technological developments on the horizon to enable more simultaneous telephony amateur radiocommunication within the present sub-allocations, although this is in itself a challenge to amateurs. Any proposed amendment to Article 5 (spectrum allocation) of the International Radio Regulations to allocate additional portions of the high frequency spectrum to the Amateur Radio Service, are at best some years in the future and only speculative. The only practical solution appears to be one of limiting access to the more crowded bands only to higher class licensees. Until such time as this becomes necessary, amateurs are encouraged to utilize other emissions and frequency bands during times of severe overcrowding of the telephony segments. Furthermore, we strongly urge that the VHF and UHF bands be utilized for all local radiocommunication; that the minimum power rules be strictly observed to minimize interference; that full carrier double sideband emission not be used in the lower four HF bands except in an emergency; and that all amateurs exercise good judgment and restraint when selecting a frequency and emission for their operation.

8. Accordingly, we conclude that the high frequency spectrum available to the Amateur Radio Service does not allow treatment which would significantly alleviate the problem of overcrowding in telephony radiocommunication through expansion of sub-band allocations. We are of the opinion that a small increase for telephony operation in the 3.5 and 7.0 MHz bands can be accommodated without causing a serious deterioration in telegraphy operation. We believe any telephony expansion of the 14.0 MHz band would result in a serious degradation to non-voice radiocommunication, and *no* expansion is adopted. Numerous comments from amateurs outside the United States express opposition to any telephony expansion by the United States, particularly in the 14.0 MHz band. Should U.S. licensees be permitted to operate in the unofficial, but widely observed, non-US telephony sub-band between 14.1 and 14.2 MHz, they predict a movement by non-US telephony stations into the 14.0 to 14.1 MHz segment, causing a deterioration in telegraphy radiocommunication and a general breakdown in inter-Region cooperation. This must not take place. We also find the 21.0 and 28.0 MHz frequency bands not to be sufficiently crowded to warrant an expansion of the telephony segments.

9. Comments from Canadian amateurs express concern for the resulting impact of expansion of the telephony segments available to US amateur below 3.8 MHz. In addition to the 2.8 to 4.0 MHz telephony sub-band authorized for both US and Canadian amateurs, they are also permitted 3725 to 3800 kHz. This concern is expressed in the comments from the Director of the Canadian Division of the American Radio Relay League. Although we do not agree entirely with the implied necessity for Canadian amateurs to operate in different sub-bands, their comments are taken into account.

> "Canadian amateur operators have always made extensive use of the 3.5 MHz band. The size of the country and the low density of population have precluded the use of other frequencies, such as 144 MHz, since they did not provide adequate coverage. It is perhaps the most widely used amateur band in Canada for internal communication, in spite of the fact that 25 kHz, (3725–3750 kHz) are shared with American Novice operators. While Canadian voice operation could and undoubtedly would be moved to some lower portion of the band such as 3650–3700 kHz, in order to avoid Novice interference, there would be less space available for other modes as a result . . . "

10. The Notice proposed 3750 to 3775 kHz for Amateur Extra Class and 3775 to 3875 kHz for Amateur Extra and Advanced Classes, an expansion of 50 kHz for telephony privileges. The American Radio Relay League, and others, recommend an expansion of only 25 kHz, limited to Amateur Extra Class operators only. This would authorize some 12 thousand higher class licensees to operate within the 3775–3800 kHz sub-band. In recognition of the Canadian operators' comments, we are of the opinion that the American Radio Relay League recommendation is a workable compromise, and we are therefore adopting it.

11. We conclude that the 7.0 MHz telephony sub-band can be expanded as proposed to the extent of permitting A3 operation between 7150 and 7200 kHz. While the comments heavily favor the adoption of this proposal, objections were also made, although to a lesser extent, by Canadian amateurs, because telephony operation is authorized in Canada by the Department of Communication for the same segment. Since the expanded telephony segment of 7150 to 7200 kHz have been heavily utilized for Novice Class A1 operation, and since only a limited number of higher class licensees will be permitted to operate within the new telephony segment, the expansion is acceptable. As a result of this action, the Novice band is relocated to 7100 to 7150 kHz.

12. The proposal to provide a telephony sub-band below 7100 kHz for contacts with stations in Region 1 and 3, is not being adopted. Numerous comments pointed out that the proposal, if adopted, would make inter-regional radiocommunication with foreign stations occupying these frequencies more difficult since Region 2 stations would overload the segment. The proposal to permit telephony operation between 7075 and 7100 kHz for American stations located outside of Region 2 is adopted, however.

13. In the interest of encouraging beginning amateur operators to gain experience in telegraphy radiocommunications, a new Novice privilege segment is adopted for 28.100 to 28.200 kHz. Observations indicate that the segments 21.200 to 21.250 MHz and 145–147 MHz are lightly occupied for Novice operation and are therefore deleted. In light of these changes, and because of the relocation of the Novice 7.0 MHz sub-band, the requirement that the transmitter be crystal controlled is removed. We are of the opinion that the technical state of the art for calibrated variable frequency generating devices in the Amateur Service permits this change and re-crystalling of the many thousands of Novice Class transmitters is unwarranted. Additionally, this will enhance the operating effectiveness of Novice operation through reduction of interference and increased operating flexibility. Since the distinctive "N" designator in a Novice Class call sign prefix is easily recognized in the Service, Novice operators are cautioned to observe strictly the authorized frequency sub-allocations for Novice Class licensees. While amending paragraph 97.7(d), we revise the wording for the 75 watt power limitation to generalize its application to other am-

plifying devices in addition to vacuum tubes.

14. As pointed out by a number of respondents, the 28 MHz frequency band does not offer itself to providing meaningful exclusive operating segments for upgrading incentives since the frequency availability problem is not of comparable magnitude as that encountered on the other high frequency bands. For this reason, the proposed establishment of exclusive operating frequency privileges for Amateur Extra Class and Advanced Class licensees is not adopted. With thousands of amateur radio operators upgrading to Amateur Extra Class and tens-of-thousands upgrading to Advanced Class, while the number of General and Conditional Class licensees is decreasing, adjustments to the sub-band allocations must be made in order to retain the incentive principle. Additional adjustments will be made periodically in the future as the upgrading movement continues. Allocations follow a pattern of apportionment of the telephony segments into three sub-bands in the case of 3.5 MHz and 21.0 MHz; one restricted to Amateur Extra exclusively; one restricted to Amateur Extra and Advanced; and one available to General/Conditional and Extra/Advanced. These-sub-band apportionments are determined by considering the number of individual licensees in each group having privileges to each sub-band weighted in favor of the higher classes. Proposed telephony sub-bands restricted to the Amateur Extra Class in the 7.0 MHz and 14.0 MHz bands are not adopted because the application of the apportionment pattern to these smaller telephony segments would result in Amateur Extra Class sub-bands so small as to be practically useless.

15. Comments received in response to the proposed reduction in the Amateur Extra-restricted telegraphy sub-band were almost entirely opposed. Reasons cited included observations to the effect that the proposed 10 kHz sub-band was too small to be meaningful, and that the restricted telegraphy sub-band was their primary incentive for upgrading. We find these comments persuasive and in agreement with our own observations. The proposal is not adopted herein, and the sub-band remains at 25 kHz.

16. We find the attached amendments to the rules are necessary and desirable and in the public interest. Authority for adoption of these amendments is contained in Sections 4(i) and 303 of the Communications Act of 1934 as amended.

17. Accordingly, IT IS ORDERED, that effective November 22, 1972, Part 97 of the Commission's Rules is AMENDED as set forth in the attached Appendix.

18. IT IS FURTHER ORDERED, that in addition to the fifteen petitions set forth in the heading to the proceeding, the pending petition of Mr. Frederick J. Hagen, filed February 1, 1971, RM-1748; and the pending petition of Mr. George W. Flyer, filed November 1, 1971, RM-1873; and the pending petition of Mr. William G. Welsh, filed November 8, 1971, RM-1880, have been fully considered and, to the extent that they are at variance with the rule changes adopted, they are DENIED.

19. IT IS FURTHER ORDERED, that this proceeding IS TERMINATED.

Federal Communications Commission
Ben F. Waple
Secretary

Attachment

NOTE: Rule changes herein will be covered by T S VI(72)-1.

APPENDIX

Part 97 of the Commission's Rules is amended as follows:

1. Section 97.7(a) and table, subparagraphs (d)(1) and (d)(2) are revised to read as follows:

§ 97.7 *Privileges of operator license*

(a) *Amateur Extra Class and Advanced Class.* All authorized amateur privileges including exclusive frequency operating authority in accordance with the following table:

FREQUENCIES	CLASS OF LICENSE AUTHORIZED
3500–3525 kHz	
3775–3800 kHz	
7000–7025 kHz	
14000–14025 kHz	Amateur Extra
21000–21025 kHz	Only
21250–21270 kHz	
3800–3890 kHz	
7150–7225 kHz	
14200–14275 kHz	Amateur Extra
21270–21350 kHz	and Advanced
50–50.1 MHz	

(d) *Novice class.* Those amateur privileges designated and limited as follows:

(1) The power input to the transmitter final amplifying stage supplying radio frequency energy to the antenna shall not exceed 75 watts, exclusive of power for heating the cathode of a vacuum tube(s).

(2) Radio telegraphy is authorized in the frequency bands 3700–3750 kHz, 7100–7150 kHz (7050–7075 kHz when the terrestrial location of the station is not within Region 2), 21,100–21,200 kHz, and 28,100–28,200 kHz, using only type A1 emission.

2. In Section 97.61, the table in paragraph (a) is amended and (b)(10) is added to read as follows:

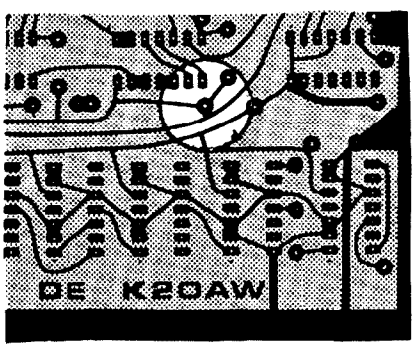
§ 97.61. *Authorized frequencies and emissions*

(a)

Frequency band	Emissions	Limitations(see paragraph (b))
kHz		
1800–2000	A1,A3	1,2
3500–4000	A1	
3500–3775	F1	
3775–3890	A5,F5	
3775–4000	A3,F3	4
7000–7300	A1	3,4
7000–7150	F1	3,4
7075-7100	A3,F3	10
7150–7225	A5,F5	3,4
7150–7300	A3,F3	3,4
14000–14350	A1	
14000–14200	F1	
14200–14275	A5,F5	
14200–14350	A3,F3	
MHz		
21.000–21.450	A1	
21.000–21.250	F1	
21.250–21.350	A5,F5	
21.250–21.450	A3,F3	
28.000–29.700	A1	
28.000–28.500	F1	
28.500–29.700	A3,F3,A5,F5	

(b)

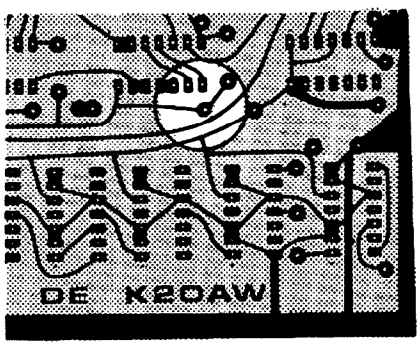
(10) The use of A3 and F3 in this band is limited to amateur radio stations located outside Region 2.



AUTHOR'S CORRECTION

On page 82 of the November **73**, in the article "Frequency Synthesizer III," Fig. 13 contains an error. One solder pad was shown merging with a wire (see detail at left). There should be no connection between them, as at the right.

. . .K2OAW



Caveat Emptor?

Price – $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor . . .

"SUPER COUNTER" . . . . to 160 MHz, five digit, AC/DC, 4.5 lbs., a professional grade counter by MIIDA, "The H.P. of Japan." $349 with 1 year warrantee. SASE for more info. NHE Communications, Bob Brunkow, (206-747-8421), 15112 S.E. 44th, Bellevue, WA. 98006.

YOUR CALL LETTERS. Two sets, for windshield and rear glass. Smart white letters with red outline. Easily installed pressure sensitive decals. $1.00, postage paid, anywhere. Satisfaction guaranteed. Lake Jordan Artists, Slapout AL 36092.

WANTED: Old Radio Transcription Discs. Any size or speed. Send list and details to Larry Kiner, W7FIZ, 7554 132nd Ave N.E.. Kirkland, Wash. 98033.

MERRY XMAS and HAPPY NEW YEAR from WØCVU. Heard around the world since 1913.

N.Y.C. HAMS NEEDED: Volunteers to operate new modern KW amateur station part time during Tue–Sat 10–4, Sunday 1–5 demonstrating to public. Have time – want to help young people? Here's your thing – Call Bob Reiley, Hall of Science of the City of New York, Box 1032, Flushing, N.Y. 11352. Phone 212-699-9400.

FOR SALE: JOHNSON 6N2 Thunderbolt, excellent – $475.00. Prefer pick up. Want Gonset 903A or 903A MK II. Jim W1VYB (617) 922–3850.

22nd ANNUAL DAYTON HAMVENTION will be held on April 28, 1973 at Wampler's Dayton Hara Arena. Technical sessions, exhibits, hidden transmitter hunt, flea market, and special program for the XYL. For info write Dayton Hamvention, Dept. 7, Box 44, Dayton, Ohio 45401.

HAVE I GOT A DEAL FOR YOU! Unusual values full reconditioned guaranteed equipment. Listed alphabetically by manufacturer. Drake 2B S169, 2NT $109, RV4 $79, TR4 $429, TR6 S395. Galaxy 300 with supply $149, GT550 both supplies $395, RF 550 $49. Gonset Communicator IV (six) $99. Hallicrafters HT 37 $149, SX101A $149. Hammarlund HQ170C $149, HQ170A/VHF $199. Heath SB301 CW Filter $199. Military R 39CA/URR S495. National NCX5 Both supplies $349, NC173 $69. Swan 260 $295. Tempo DC1A $69, Tempo 2000 Linear $339. Lots more. Get complete listing. New Drake, Galaxy, Hallicrafters, HyGain, Kenwood, Newtronics, Regency, Tempo. Stan Burghardt, Box 73, Watertown, S.D. Phone 605-886-3767.

$229.95 GETS YOU 30 Watt 5 channel base station on 94 Simplex: Mikes $13.00 Extra. Send Money Orders to: H & B Sales, P.O. Box 168, Brooklyn, New York 11228.

TECH MANUALS for Govt surplus gear only S6.50 each: R-388/URR, R-389/URR, R-390/URR, R-220/URR, R-274/FRR, CV-591A/URR, ALR-5, URM-25D, TT-63A/FGC. W3IHD, 4905 Roanne Drive, Washington DC 20021.

BRAND-NEW 4 channel Hi-Band G.E. Master Royal-Pro transceiver 35 Watts Solid-State trunk mount low split 132–151 mhz. 4-TX Icom and 6-RX crystals for 2mfm. $800.00. J.A. Smith, P.O. Box 2065, Newburgh N.Y. 12550. Tel 914-562-4300 or 914-562-2285.

STANDARD 826m 2 meter FM 12 channels 6 with xtals plus sub-audible tone encoder and reed and base station power supply. All A-1 condition. S250.00. J.A. Smith, P.O. Box 2065, Newburgh N.Y. Tel. 914-562-4300 or 914-562-2285.

REPEATER IDENTIFIER: 110 V.A.C.; I.D.'s each transmission; with auto-hold; programmed with your call in matrix: $60; W9BLR, 9434 W. Mitchell, West Allis, Wisconsin 53214.

CLEANING HOUSE: Digitec digital voltmeter model 201 $40; TS268 $5; Many other items; J. Buckler, 29 Parkview Drive, Plains PA 18705.

HOOSIER ELECTRONICS – Your ham headquarters in the heart of the Midwest where only the finest amateur equipment is sold. Individual, personal service by experienced and active hams. Factory-authorized dealers for Drake, Regency, Standard, Ten-Tec, Hy-Gain, CushCraft, Ham-M, plus many more. Orders for in-stock merchandise shipped the same day. Write today for our quote and try our personal, friendly Hoosier service. Hoosier Electronics, R.R.25, Box 403, Terre Haute, Indiana 47802.

SAROC Eighth National Convention – the PRESTIGE convention at the Flamingo Hotel Convention Center, Las Vegas, Nevada 89109, January 4 through 7, 1973. SAROC special room rate $15.00 plus tax, per night, single or double occupancy, only 500 rooms, so get your accommodations request in early. Advance Registration $10.00 per person. Registration and eyeball session on Thursday. Seminars, Meetings, Exhibits, open Friday and Saturday. SAROC-SWAN Electronics Social Hour, Friday. Ladies Program, Saturday. SAROC Sixth National FM Conference, Friday and Saturday. SAROC-HY-GAIN/GALAXY Cocktail Party, with Leo WØGFQ, at the Organ, Saturday. SAROC Buffet Hunt Breakfast, with Champagne, Sunday. Advance Registration with Sergio Franchi Flamingo Midnight Show, two drinks $17.00 per person. Advance Registration with Sergio Franchi Flamingo Dinner Show, no drinks, $21.00 per person. SAROC Jet Roundtrip Vacation Package Plan includes airfare, deluxe Flamingo Hotel Room for three nights, SAROC Advance Registration with Flamingo Hotel Dinner Show: via United Airlines departure cities; Baltimore/Washington, $287.00; Boston, $316.00; Chicago, $228.00; Cleveland, $256.00; Columbus, $251.00; Detroit, $249.00; Hartford, $310.00; Milwaukee, $233.00; New York/Newark, $303.00; Philadelphia, $296.00; Pittsburg, $268.00; via Frontier Airlines departure cities: St. Louis, $214.00; Kansas City, $192.00; Denver, $137.00; Omaha, $186.00; Lincoln, $180.00. The price quoted is per person, double occupancy in hotel room. If single occupancy in hotel room is desired add $25.00 additional per person to each amount quoted. All fares and schedules are subject to CAB rules and regulations – send for additional details. Remember to send accommodations request to Flamingo Hotel. Send Advance Registration and information request to, SAROC, P.O. Box 73, Boulder City, Nevada 89005."

ARRL REPORT WANTED. A $5 reward is offered for a readable copy of the 1971 ARRL yearly report. The League claims they sent them all out and have none available for members, even Lifetime members. Please send report to Box 2864, 73 Magazine, Peterborough NH 03458.

KLEINSCHMIDT MANUALS, Mite KSR, teletypewriter supplies, gears, parts, covers. Send SASE for list. Buy, too Teletype manuals wanted. Typetronics, Box 8873, Ft. Lauderdale, Fla. 33310, W4NYF.

SELL: E.E. and other technical books. SASE for list. Roger A. Baim, WB9BDP 2753 W. Coyle, Chicago, Ill. 60645.

Continued on page 146...

James D. Pryor, Jr. WØIPB
626 North Erie
Wichita KS 67214

NON-SQUIRRELY TWO METER PREAMP

During my years of experimenting with 2 and 6 meters, I have built a number of things such as preamps and converters using tubes, nuvistors, transistors and FET's, including the well-known 3N128 Mosfet. I recently tried a circuit using an MPF-107 FET in a common source configuration. The circuit herein described, if followed closely, will produce a non-critical two meter preamp second to none. Nor is there any neutralization required.

This preamp can be built on a home brew printed circuit board with ease. The board need be only about 2½ in. square. All leads should of course be kept as short as possible. The coil forms should be quarter inch with white powdered iron cores. The preamp should draw about 15 mils. Tuneup is accomplished by tuning for maximum first limiter current, or maximum S meter reading. This circuit is basically for 146.94 MHz, but should be adaptable for any two meter frequency.

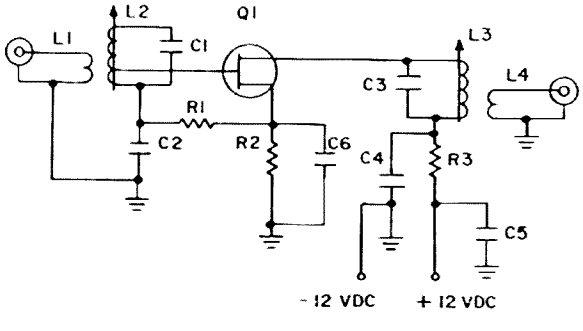


Fig. 1. 2m FM preamp. L1 & L4, 2T No. 22 hookup on cold end of L3; L2 & L3, 3½T No. 16 spaced the dia. L2 & L3 must be wound opposite directions; C-1, 10 pF; C-2, 470 pF; C-3, 10 pF; C-4, 470 pF; C-5, .01; C-6, 470 pF; R-1, 220 ohm ½W; R-2, 370 ohm ½W; R-3, 22 ohm ½W; Q-1, Motorola MPF-107 or HEP 802.

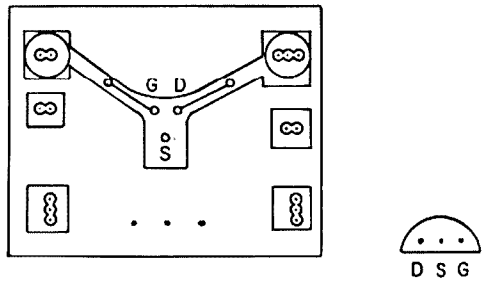


Fig. 2. Printed circuit layout. Drain and source interchangeable.

I have been unsuccessful in all attempts to make the preamps break into oscillation while properly connected. This unit will bring a one microvolt sensitivity to less than four- tenths microvolts for copyable signal.

This article is intended basically for the FMer but should not be overlooked by the SSB and AM boys either. There are several of these preamps in use today here in Wichita by very satisfied base stations and mobiles.

I would like to express my appreciation to Wayne McVay (WAØPLY) for his part in the discovery of this very successful circuit. Apply your 12V dc and hear signals that you never knew were there.

. . .WØIPB

3rd PARTY REGULATIONS

In the matter of inquiry into the extent to which amateur stations should be used on behalf of non-amateur organizations.
Docket No. 19245, RM-1687
Released October 11, 1972

By the Commission: Commissioner Johnson dissenting; Commissioner Reid absent.

1. On April 28, 1971, the Commission issued a Notice of Inquiry in the above-entitled matter. The Notice which was published in the Federal Register on May 8, 1971 (36 F. R. 8611) requested that comments be filed by interested parties by July 1, 1971. Subsequently, the time for filing comments was extended to August 31, 1971. Seventy-five comments were filed by both individuals, amateur organizations, and other organizations which have in the past used the facilities of amateur radio stations.

2. The Notice of Inquiry was the proximate result of §97.39 which prohibits certain organizations from both obtaining an amateur station license or having an amateur operator use his station on behalf of those organizations. One of the effects of this Rule is to prohibit amateur operators from using their stations on behalf of such parties as the Eye Bank, American Red Cross and the March of Dimes as well as commercial businesses.

3. Our Notice requested comments regarding whether any restriction on the use of amateur radio stations by non-amateur organizations is needed. We also requested comments on what those restrictions should be. The Notice further related to the fact that unlimited operation on behalf of organizations (third party communications) could lead to the creation of large numbers of new networks which would create additional unwarranted interference on the amateur bands.

4. The comments received in the Docket suggested many solutions to the problem of which organizations, if any, should be allowed to use amateur radio facilities. The comments covered the full range from no third party communications to any communications that individual amateurs wish to carry. Most of the comments advocated a position between those two positions. Three comments suggested that amateur radio be used on behalf of non-amateur organizations but only when normal communications are unavailable. Many other comments suggested that third party communications be allowed for charitable nonprofit organizations but only during emergencies. A majority of the comments agreed that it is not a sound practice to allow commercial organizations to use amateur radio stations, but there was no consensus as to what other organization should have use of amateur stations.

5. The Commission believes that the best solution lies between the extremes of prohibiting entirely third party communication and permitting unlimited third party operations. To prohibit entirely third party traffic would tend to stifle one of the basic purposes of the Amateur Radio Service which is to provide a voluntary non-commercial radio service. But to allow all third party communications would tend to cause increased congestion in the Amateur bands.A basic principle permeating our rules and the international radio regulations is that amateur radio shall not be used for any pecuniary interest to any party or for commercial communications. The international rules specifically provide that amateur radiocommunications must be of a technical nature or remarks of a personal character for which, by reason of their unimportance, recourse to a public telecommunications service is not justified. There can be no legitimate reason for an amateur station to carry message traffic of a commercial nature. Radiocommunications, the sole purpose of which is to facilitate regular business or commercial activities, do not enhance the intended purpose of the Amateur Service and should not be allowed except for an emergency communication as defined in our rules

6. Several comments were received which suggested that the thrust of the Commission's Notice of Inquiry was to censor the Amateur Radio Service. These comments suggested that any categorization of groups, some of which could use amateur radio facilities and others who could not, would be in violation of §326 of the Communications Act of 1934 which prohibits censorship of radio communications. It has been established, however, that eligibility restrictions and reasonable rules limiting communications to those consistent with the purpose of the radio service involved are within the scope of the Commission's authority. See, *Lafayette Radio Electronics Corp. v. United States,* 345 F2d 278 (2nd Circ. 1965). Moreover, it is not only permissible but an affirmative duty of this Commission to classify radio stations and to regulate the nature of the radiocommunication service that is to be rendered by stations in that class. See §303(a) and (b). Our rules adopted today regarding commercial third party traffic merely regulate generally the nature of the radio communication service which may be rendered by amateur stations.

7. The Rules adopted today will delete the phrase "nor for its use" which is contained in §97.39. The result of this action will make §97.39 a rule concerned only with who or what organizations may obtain a license. The amended §97.39 will not be directed to permissable communication nor to the use of an amateur station.

8. We are adding a new section, §97.114, which will both prohibit commercial third party traffic and clarify the permissible international third party traffic. As to the provisions of subparagraph (a) concerning international third party traffic, these rules simply incorporate the already existing international rules. As such they make no change in permissible communications and they are therefore considered to be of an editorial nature. Subsection (c) of §97.114 prohibits corporations, companies, associations and other organizations engaged in commercial activities from using amateur radio facilities. It will not prohibit the use of the Amateur Radio Service on behalf of organizations such as the Eye Bank and the American Red Cross except for traffic which relates to the regular business affairs of those organizations. Subparagraph (b) will prohibit amateur control operators or station licensees from receiving any compensation including a salary or reimbursement for non-collect telephone calls for operating an amateur station for transmitting or delivering third party traffic. This provision explicitly sets forth the fact that both domestic and international amateur traffic must not be handled with a pecuniary interest in mind.

9. To prevent unnecessary confusion as to what is meant by third party traffic, we are adopting a definition of that term and are making editorial changes in §97.79(d).

10. The provisions of §97.114(b) and 97.112 will clearly prohibit the American Radio Relay League's long

standing practice of providing compensation to the control operators of station W1AW. As a consequence, we are today issuing a Notice of Proposed Rule Making in a separate proceeding which would allow in certain instances involving club stations the compensation of control operators. We are also herein granting a waiver of the necessary rules to the licensee of station W1AW to allow the station to continue to operate pending the final action on our Notice of Proposed Rule Making. Any other club station providing similar services as W1AW may apply for a similar waiver. Such requests will be handled on a case by case basis.

11. The American Radio Relay League and several other individuals filed comments which suggested that the Commission adopt a rule specifically prohibiting communications for any purpose or activity which is contrary to federal, state, or local law. We find that this suggestion as it applies to any radio communications including third party traffic, has substantial merit. Therefore, with certain editorial changes, we are adopting their proposal as §97.116.

12. Authority for the rule changes adopted herein is contained in Sections 4(i) and 303 of the Communications Act of 1934, as amended.

13. The Commission finds that further Public Notice in regard to the subject matter of this Report and Order is unnecessary. Notice of the general subject matter and of the issues involved was previously given and extensive comments from interested parties have been received and given careful consideration. No public interest would be served by further notice and public participation in this matter.

14. IT IS ORDERED, effective December 1, 1972, that Part 97 of the Commission's Rules is amended as set forth in the attached Appendix.

15. IT IS FURTHER ORDERED, that a waiver of §§97.112 and 97.114(b) is GRANTED to the licensee of amateur station W1AW.

16. IT IS FURTHER ORDERED, that RM-1687 is denied to the extent that it is inconsistent with the rules adopted in this Report and Order and that this proceeding is TERMINATED

Federal Communications Commission
Ben F. Waple
Secretary

NOTE: Rules changes herein will be covered by T.S. VI(72)-1.

APPENDIX

Part 97 of the Commission's Rules is amended as follows:

1. Section 97.3(w) and (x) is added as follows:

§97.3 *Definitions*

(w) *Third party traffic.* Amateur radiocommunication by or under the supervision of the control operator at an amateur radio station to another amatuer radio station on behalf of any one other than the control operator.

(x) *Emergency communication.* Any amateur radio communication directly relating to the immediate safety of life of individuals or the immediate protection of property.

2. Section 97.39 is amended to read as follows:

§97.39 *Eligibility of corporations or organizations to hold station license.* An amateur station license will not be issued to a school, company, corporation, association, or other organization, except that in the case of a bona fide amateur radio organization or society, a station license may be issued to a licensed amateur operator, other than the holder of a Novice Class license, as trustee for such society.

3. Section 97.79(d) is amended to read as follows:

§97.79 Control operator requirements

(d) The licensee of an amateur radio station may permit any third party to participate in amateur radio communications from his station, provided that a control operator is present and continuously monitors and supervises the radiocommunication to insure compliance with the rules.

4. Section 97.114 is added to read as follows:

§97.114 *Third party traffic.*

The transmission or delivery of the following amateur radiocommunication is prohibited:

(a) International third party traffic except with countries which have assented thereto;

(b) Third party traffic involving material compensation, either tangible or intangible, direct or indirect, to a third party, a station licensee, a control operator, or any other person.

(c) Except for an emergency communication as defined in this Part, third party traffic consisting of business communications on behalf of any party. For the purpose of this section business communication shall mean any transmission or communication the purpose of which is to facilitate the regular business or commercial affairs of any party.

4. Section 97.116 is added as follows:

§97.116 *Amateur radiocommunication for unlawful purposes prohibited.* The transmission of radiocommunication or messages by an amateur radio station for any purpose, or in connection with any activity, which is contrary to Federal, State, or local law is prohibited.

Notice of Proposed Rule Making
Docket 19605

In the matter of Amendment of Part 97 to allow the compensation in certain instances of control operators of stations operating in the Amateur Radio Service and modification of the logging requirements regarding third party communications.

Adopted: October 5, 1972

Released: October 11, 1972

By the Commission: Commissioner Johnson dissenting; Commissioner Reid absent.

1. In our Report and Order adopted today in Docket 19245 we established rules regarding the type of third party traffic that amateur licensees may properly handle including the compensation of control operators for transmitting such messages. The Commission hereby gives Notice of Proposed Rule Makin concerning the collateral issues of compensation of amateur club station control operators and possible relaxation of the logging requirement for third party communications.

2. The American Radio Relay League operates an amateur station that is engaged in multiple address point to point communications. They broadcast bulletins, informational matter, and code practice of particular significance to amateur licensees. This type of communication is highly beneficial to both amateur operators and the Amateur Radio Service and should be encouraged.

3. The equipment used by these stations is in many instances as complex as a standard or FM broadcast station. As a result, it is impractical to operate these stations with volunteers, especially if the station operates for a substantial period each week.

4. The Commission is considering two different solutions. First, we are proposing specific rules which are designed to allow any bona fide amateur organization to operate a station and provide reasonable compensation to the control operator when the station transmits material solely related to the Amateur Radio Service. The rules, which will be designated as §97.112(b) set forth specific criteria which a club station must meet in order to provide compensation to their operators. These criteria are designed to insure that stations compensating their operators are in fact en-

Continued on page 146.

FCC continued from p. 140.

gaged in providing a service to a significantly large sement of amateur licensees. Another solution would be to create a new class of amateur station which will be required, before they will be licensed, to make a showing similar to our proposed rules contained in the attached appendix. Comments are invited regarding these two possible solutions and any other proposals regarding this type of operation.

5. Section 97.103(b)(3) requires that an amateur radio station log include a notation of third party messages sent or received, including names of all participants and a brief description of the message content. The Commission invites comments regarding the usefulness of this requirement and whether it should be modified or deleted.

6. Authority for the proposed rule changes contained herein is contained in §§4(i) and 303 of the Communications Act of 1934, as amended.

7. Pursuant to applicable procedures set forth in Section 1.419 of the Commission's Rules, an original and 14 copies of all material requested by this proceeding should be submitted on or before December 20, 1972, and reply comments on or before January 3, 1973. All relevant material will be considered by the Commission. In reaching its decision in this proceeding, the Commission may also take into account other relevant data before it in addition to the specific data invited by this Notice. Responses will be available for public inspection during regular business hours in the Commission's Public Reference Room at its headquarters, 1919 M Street, N.W., Washington, D.C.

Federal Communications Commission
Ben F. Waple
Secretary

APPENDIX

In Section 97.112, the present text is designated as paragraph (a) and a new paragraph (b) is added to read as follows:

§97.112 *No remuneration for use of station*

(b) Control operators of a Club Station may be compensated when the club station is operated primarily for the purpose of conducting amateur radiocommunication to provide code practice transmissions intended for persons learning or improving proficiency in the International Morse Code, or to disseminate information bulletins consisting solely of subject matter having direct interest to the Amateur Radio Service provided:

(1) The station is operated weekly for a period of at least 40 hours;

(2) The station schedules operations on all allocated high frequency amateur bands using reasonable measures to maximize coverage;

(3) The schedule of normal operating times and frequencies is published at least 30 days in advance of the actual transmissions;

FCC

....LETTERS continued

I am in search of information concerning a surplus U.S. Navy receiver. Type CAY 46077 2–20 MCS in 4 Bands. A unit of RBM-4 Radio Equipment manufactured for the Navy Department – Bureau of Ships. I am primarily concerned in obtaining a circuit diagram of this rcvr. and also a circuit diagram of the proper power supply for this unit. Possibly one of your readers could help me with this.

S.E. Williams VE3AZD
14 Cheshire Dr.
Islington Ontario
Canada

Re your comments on Sept 72 editorial page titled "Incentives." Ever since the "spokesman for U.S. amateurs' started promoting incentive licensing, the prime question goes begging, namely, WHAT incentive? A follow-on question is: What benefits? If new frequencies or other rewards were given to those attaining advanced licenses, the term incentive would have been valid. If the majority of amateurs ever bother to earn their extra, those narrow segments will be just as crowded as the segments allowed general and advanced. This would reduce the extra license to a mere status symbol.

I am also in favor of the amateur updating his technical knowledge (I recently did when I had to repair my transceiver – the company went out of business.) I question how much knowledge is gained and retained by marking a series of multiple choice questions. From my listening, I fail to detect any improvements attributable to incentive licensing. And like you, Wayne, I also have trouble equating higher code speed to operate on extra phone frequencies.

In sum, I hold the FCC equally culpable for buying the gold brick as peddled by that group in Hartford. Unfortunately for all of us (who were not even consulted) the ill conceived laws stay on the books as long as the good laws.

Amateur radio needs stalwarts like you, Wayne, so please don't give up the ship (73). And when you run for Director – I will move back to the first district just to vote for you.

F. E. McAllen W2SPB
Asbury Park NJ

The 5/8 wavelength vertical using a weather balloon (Oct. '72 73, p. 60) looks like a great idea for field-day expeditions, but, knowing how the high impedance end of a whip can produce lightning displays, especially when driven by a gallon at low frequencies, I wonder about the safety of persons and facilities on the ground as the then-flaming hydrogen-recommended sphere descends. Remember the Hindenburg?

Bob Hirschfeld W6DNS
Cupertino CA

We're still running . . .

I am presently studying amateur radio at night school. VE3GCP is our teacher. He is the president of the Hamilton Radio Club and delegate to the Ontario Radio Society for the Niagara region.

I built the pre-Novice xmtr of WA8OIK in the January 73 issue. It works fine and is a real help.

Charles McBride

Caveat Emptor continued.

ANTIQUE COLLECTORS: Tubes for old sets. Trade-sell, new UX200 (RCA) $5, US201A $5, UX30 $2, SASE for list. WA4NED, Box 468, Gainseville, Georgia 30501.

DIVORCE and alimony dictates that I sell the following fast: CLEGG FM-27A, $300., Pair of Standard 146, $210 ea., First check takes each item. All like new condx. Box 2611, 73 Mag.

BEING DRAFTED. Anyone want a good deal? Mint Standard SRC 826M $250. Excellent condition Clegg FM-27A $300. Mini-vox IVL Walkie-talkie. Make offer. Box 3246 73 Mag.

B. & W. 6100 for sale. Low mileage, factory inst. F.S.K. Excellent Cond. C. E. Heisler, 115 Dixie Drive, Red Lion PA 17356. Phone 717-244-2212.

"HOSS TRADER Ed Moory" says he will not be undersold on Cash deals! Shop around for your best price and then call or write the "HOSS" before you buy! New Regency HR-212 two meter FM transceiver, 20 watts, amateur net, $259.00: Factory Authorized Dealer for new Drake, Collins, Hallicrafters, and more: write for quote! New Rohn 50 ft. foldover tower, prepaid, $239.00: New Mosley CL-33 and demo Ham-M rotor, $215.00: Used equipment: like new "demo" Collins 75S-3C, $795.00: "Perfect" L4-B linear, $525.00: MN-2000, $149.00: R4-B, $349.00: T4-XB, $375.00: Ham-M, $85.00: Moory Electronics Co., P.O. Box 506, DeWitt, Arkansas 72042, Tel: 501-946-2820.

TECHNICAL AID GROUP

The Technical Aid Group is a group of hams who have indicated a willingness to share their knowledge and skills with others. They have volunteered to be of service to fellow hams and do so without compensation. If you have a technical question, look over the list to see who has competency in the area of your question. For many of the TAG members, descriptions of all areas of expertise would be lengthy, so an abbreviated description is given. When stating your problem, give as much information as possible and clearly state the difficulty. Enclose a SASE for reply.

For those hams who have a desire to share, the TAG is the thing for you. Send a brief note requesting the membership form, fill it in and send it back. It asks a few questions about your qualifications, and there is a check-list to indicate your fields of competence. These cover all modes currently used by hams, antenna design and theory, transmitter and receiver design for HF, VHF, and UHF, logic, ICs, general help, and other areas. As more members are added, their names and addresses will be published.

This list is not complete, but represents those former TAG members who have responded to a recent mailing and have expressed a desire to continue in the program. Comments from them indicate that they have enjoyed helping and all have been contacted frequently for advice.

Robert Perlman WB2VRW, 3 Josten Place, Hudson NY 12534. Electrical engineering student. Will help with Novice transmitters and receivers, and any help for beginning hams.

Thomas Laffin W1FJE, Box 133, Hillsboro NH 03244. Radio communications technician. Special aid to ex-CBers and those who need terms in easily understood terms; aid to Novices and Techs interested in MARS, RACES, CD, and CAP; how to build and scrounge parts; assistance on ham history, ATV, microwave, and general help.

Theodore Cohen W4UMF, 8603 Conover Pl., Alexandria VA 22308. Geophysicist. Specially prepared to answer questions about SSTV and ATV.

J. Bradley Flippin K6HPR, 116 Montecito Ave., Apt. M., Monterey CA 93940. Electronic engineer. Help with RTTY, data processing and programming, general.

Ira Kavaler WA2ZIR, P.O. Box 54, Flatbush Sta., Brooklyn NY 11226. Electrical engineer. Assistance offered in theoretical aspects of electricity and electronics from dc to UHF, design of equipment, computer programming, and signal circuit (failsafe) design.

Jon Teich WB2JAE, 22 Olden Rd., Edison NJ 08817. High school student. Novice and others, transmitter and receiver problems, logic, and general.

David Felt WB6ALF, P.O. Box 261, Sierra Madre CA 91024. Electronics engineer. Qualified help in logic, digital and analog design, solid state, AM and TV.

Robert Groh WA2CKY, 65 Roxborough Rd., Rochester NY 14619. Communications engineer. Bob can lend a hand in HF and VHF transmitter and receiver design as well as solid-state logic and digital techniques.

Carl Miller WA6ZHT, 334 Paragon Ave., Stockton CA 95207. Computer technician. Carl's specialty area is solid-state QRP.

George Daughters WB6AIG, 1560 Klamath Dr., Sunnyvale CA 94087. Research associate. HF transmitter and receiver, SSB, and solid state, are George's fields.

D. Hausman VE3BUE, 267 Northcrest Pl., Waterloo, Ontario, Canada. Student. Novice transmitter and receiver problems as well as logic, digital techniques and ICs.

Hugh Wells W6WTU, 1411 18th St., Manhattan Beach CA 90226. Electronics instructor. Hugh can help with AM, Novice problems, VHF-UHF receivers and converters, solid state, test equipment, FM and repeaters, and general help.

Charles Hill WA7LQO, 4005 Campbell St., Baker OR 97814. Student. TV, Novice transmitter problems, and logic.

John Perhay WAØDGW, Route 4, Owatonna MN 55060. EE technician. John will help with RTTY, AM, SSB, Novice gear, HF transmitters and receivers, solid state, ICs, and test equipment.

Jim Jindrick WA9QYC, 801 Florence Ave., Racine WI 53402. Consulting engineer. General help as well as HF, VHF, and UHF antennas, transmitters, and receivers.

William Welsh W6DDB, 2814 Empire Ave., Burbank CA 91504. Electronic engineer. Beginner's problems, code instruction, theory and regulations.

Ken Knecht K8VNT, Box 39, Clintondale NY 12515. Television engineer. TV, logic, and digital techniques.

Tom O'Hara W6ORG, 10253 E. Nadine St., Temple City CA 91780. Communications engineer. RTTY, TV, AM, SSB, VHF antennas, transmitters and receivers for HF through UHF, solid state, and general help.

Bruce Creighton WA5JVL, 2517 Metairie Ct., Metairie LA 70002. Electrical engineer. Antennas, Novice problems, solid state, logic, digital techniques, test equipment, and general help.

Tom Borok WB2PFY 215-33 23 Rd., Bayside NY 11360. Student. Tom is especially qualified to help Novices with their problems with transmitters and receivers, HF and VHF antennas, HF receivers, test equipment, and surplus, Morse code instruction.

Roger Taylor K9ALD, 2811 William St., Champaign IL 61820. Engineer. Roger is adept with AM, SSB, antennas, solid state, logic and digital techniques, ICs, test equipment, and other general help.

Orris Grefsheim WA6UYD, 1427 W. Park St., Lodi CA 95240. TV technician. Orris is capable of assisting in all fields of amateur work, DC through UHF, logic as well as Novice help.

John Allen K1FWF, 112 Edgemoor Lane, Ithaca NY 14850. Technical director. John's areas of assistance are VHF and UHF antennas, receivers, and transmitters, solid state and digital techniques, ICs, and SSB.

...AND MORE!

I was very interested in the WWVB receiver article in the latest issue, even though so far as I know WWVB cannot ordinarily be heard in this area.

I have been trying without any success to find details of LORAN C on 200 kHz. I made a trip to the Coast Guard Station at Woods Hole, but nobody there would tell me anything.

Can you tell me where to get info on this? ditto for OMEGA system?

I should be most appreciative of any help you can give me.

Bill Hunt
336 Marion Road
Middleboro MA 02346

Does anyone have the information Bill needs?

Having trouble with buzzes, yoops, and music from that nearby broadcast station?

Well, put on your old shoes, coveralls, and take a swig out of that hidden bottle of bug juice, and crawl under the house with a flashlight, some bare wire, a file, and a wiping rag or two.

If you find pipes and conduit crisscrossing, or laying upon one another, pry them apart, and put something in between, such as friction tape or old newspapers.

If the pipes can't be pried apart, bind them together wherever they touch. It's usually a dirty job, but will probably put a stop to your trouble.

It's called cross-modulation, and if you are getting music from that pesky broadcast station, you can often stop it for good, and your DX cards from the other side of the world might arrive more often.

W6TG
Reseda CA

In the November 1972 *Stereo Review* there is an article by one Peter Sutheim on "Radio-Frequency Bugs in your Audio System." The article is apparently quite good as far as technical solutions are concerned, but portrays amateurs in the same bag with CBer's as "casual" users of the airwaves who "may not give a damn." I would hope that you and others could find the time to read the article – it reveals the kind of PR problems that we must contend with. I have written a short, polite letter to Mr. William Anderson, the editor of *SR*, to clarify Sutheim's misconceptions and would strongly encourage as many other hams as care about their avocation to do likewise.

If we can't beat RFI, it's going to beat us – for good.

William M. Klykylo WA8FOZ
Ann Arbor MI

I have read with great interest, W9JT's "Petition" in the October issue. His suggested allocations of the amateur frequencies suggest three things to me:

1. HIS favorite mode of transmission is SSB.
2. He seems to think that amateurs have no purpose except to chew the fat.
3. He is an extremely selfish indi vidual.

His impression of amateur service is that hams are nothing more than a lot of people competing for spectrum space to talk, largely about nothing. Unfortunately, a large number of hams have the same impression. They, and Mr. Fyler, should comply with the FCC requirement that amateur operators be familiar with the domestic and international regulations governing amateur service. Specifically, they should read that part of the Geneva radio regulations where the amateur service is defined, "A service of self training and technical investigations carried on by amateurs . . ." This very definition would be completely invalidated, were Mr. Flyer's recommendations or any like them ever adopted.

The present amateur service knows many modes of transmission. Consequently amateur radio has always served as a source of self trained personnel for all phases of the communications industry. In spite of the great popularity of SSB fone, all the present modes of transmitting information have, and always will have, their place. For example, AM phone is still the prime means of voice transmission outside of the amateur service. (Name one commercial broadcasting station that uses suppressed carrier single sideband.) FM phone holds a close second. There are still a great many commercial and government CW stations. How can there be any self training if these still widely-used techniques are closed to the amateur?

In the amateur service itself, AM phone still offers audio quality far superior to SSB. I am yet to hear the SSB station that, even on equipment designed for SSB, sounds any better than a constipated duck. Phone nets are, in fact, handicapped when they use SSB since every station must be within a few Hz of net frequency – a difficult thing to achieve, even with today's sophisticated equipment. Without intending to degrade the many capable operators who utilize SSB, I must also say that I have run across many operators who now don't know how to properly tune in an AM signal and whose equipment gives decidedly inferior performance when receiving an AM signal. On the other hand, SSB certainly is the better medium for casual conversation.

For handling third-party traffic, CW cannot be beat. I won't elaborate on this; I will merely suggest listening in to a phone net, then to a CW net.

RTTY is also superior to phone for message traffic, although, because of its extreme complexity, I feel it is still second to CW.

If Mr. Fyler's recommendations were ever adopted, the ham bands would shortly become more polluted than Lake Erie. His statement that "It is imperative that SSB fone have the right of way over CW . . ." betrays him as the sort that would eventually degenerate amateur radio to the point of eliminating CW altogether, leaving his favorite medium in exclusive control of the entire amateur spectrum and cluttering it with the multitudes of individuals who today are crying in their beer that they can't learn the code which, to date, millions of eleven-year-old boy scouts have learned. We've kooks enough on the air without that lot.

I recently received a letter from WA4RMF asking for an article enumerating the contributions of amateurs to progress in the electronic industry. No mere article, not even a full-sized volume, can do justice to this subject. The better engineers and technicians in every electronic firm in the country, and most commercial radio and TV stations are hams, to say nothing of the hams that pervade the telephone companies, and recording studios. The bulk of them got their start as amateurs. I am indebted to my hobby for a fifteen-year career in electronics. I know as a fact that many ideas which are eventually absorbed in commercial and military hardware have their origins in amateur tinkering – the hams merely take them to work next day and use them. How could amateur radio ever continue this contribution to progress if it is stifled for the convenience of a large number of gasbags? Our hobby presently offers a great many outlets for public service, personal and cultural improvement, and development. It has been so from its beginning, and he that will so demean himself so as not to be endeavoring to add to his stock of knowledge and operating skill may be deemed a drone on the airways – a useless member of the fraternity and totally unworthy of being called a radio amateur.

W2FEZ

P.S. I've got a sneaky feeling you will disagree with me and support W9JT. If so, I hope you will still be man enough to print this letter.

There is some weird idea going around that I censor the stuff I print in 73, and that, therefore, everything I publish means that I agree with it. This is not the policy of 73 – this never has been the policy of 73 – and I hope it never will be the policy of 73. Just because your adored QST seems to operate this way does not mean that 73 is going to imitate them. Stuff is printed in 73 that appears to be of interest, whether I think it a bunch of bananas or not . . . wayne.